SCIENTIFIC AMERICAN

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A GREAT BRONZE CASTING.

The steps in the naturalization of a foreign industry in this country are always of interest. For many years monumental bronze casting was peculiarly a foreign art. Munich or Paris was called upon when statues of generals or other distinguished men were to be produced. Within a few years several bronze foundries have been started in this country. One of the most recent is illustrated here. It is of interest, as being in New York City, and as having recently been the scene of the heaviest bronze casting yet made in America.

The Union Pacific Railroad decided to place a bronze buffalo's head over the eastern portal of their new bridge at Omaha. The design was most fitting, as the crossing of the Missouri River signalizes the traveler's entrance into the old buffalo ranges, now unfortunately deserted, and deprived by death and flight of their former tenants. Mr. Edward Kemys, Jr., of this city, was the artist selected for the work. His model, executed with great vigor and depth of cutting, represented the well-known bison's head, adapted by its boldness of design to the elevation it was to be placed at. It is about nine feet high. Mr. Etienne Favy was selected as the founder. His foundry, also in this city, is probably the best arranged in the country. He undertook the task of casting the great head in one piece, with the exception of the horns. These were cast separately. To obtain some idea of the intricacy of the mould and core, the illustration of the great head should be consulted; the bold contour, with deeply sunken eyes and nostrils, and the surface of the head completely covered with curling hair, involving a great amount of undercut work.

The mould was made under the direct supervision of Mr. Favy. Two men's labor for three months was devoted to it. Probably as many as 1,200 pieces entered into the composition of the mould. Each piece had its own separate frame or backing of iron rods, forged to suitable shape and outline. When finished, it was taken to pieces and removed from the model, and again set up. It was next used for forming the core. This was made within it. Then piece by piece the intricate mould was again taken apart and withdrawn, leaving the solid core, itself a model of the head. This had to be reduced in size. Three days were devoted to carefully reducing it by paring off its surface. The object was to execute this work so as to leave a space of ¼ inch thickness for the metal to run in.

The mould with the core within it, leaving the space alluded to, was set up. The drying of the two parts was executed, not in the usual drying oven, but in the moulding pit itself. The Favy foundry is peculiarly fitted for heavy work, as, in addition to several crucible furnaces, it has a reverberatory furnace, on whose hearth several thousand pounds of metal can be fused in one heat. Directly in front of this furnace, the casting pit was arranged. It was deep enough to receive the mould, with three feet or more to spare. Near its bottom several large grates were placed, and on them the fires were started to dry the mould and core. Flues led the products of combustion away from the pit. For ten days the fires were kept up. After this period, they were allowed to die out.

As the object was so large and intricate, it was decided to adopt the process of bottom casting. As will be obvious from the description, this secures the purest metal. A large, deep flask was prepared with clay lining of sufficient capacity to hold over six thousand pounds of metal. In its bottom two holes were made, which could be closed by plugs of iron. The plugs rose above the top of the flask and terminated in eyes, so that they could be simultaneously extracted. The two apertures corresponded in distance apart with two openings in the top of the mould. From the latter a number of diverging gates or channels for the metal ran to all parts of the head. The idea was to place the metal reservoir solidly on top of the mould, to set the

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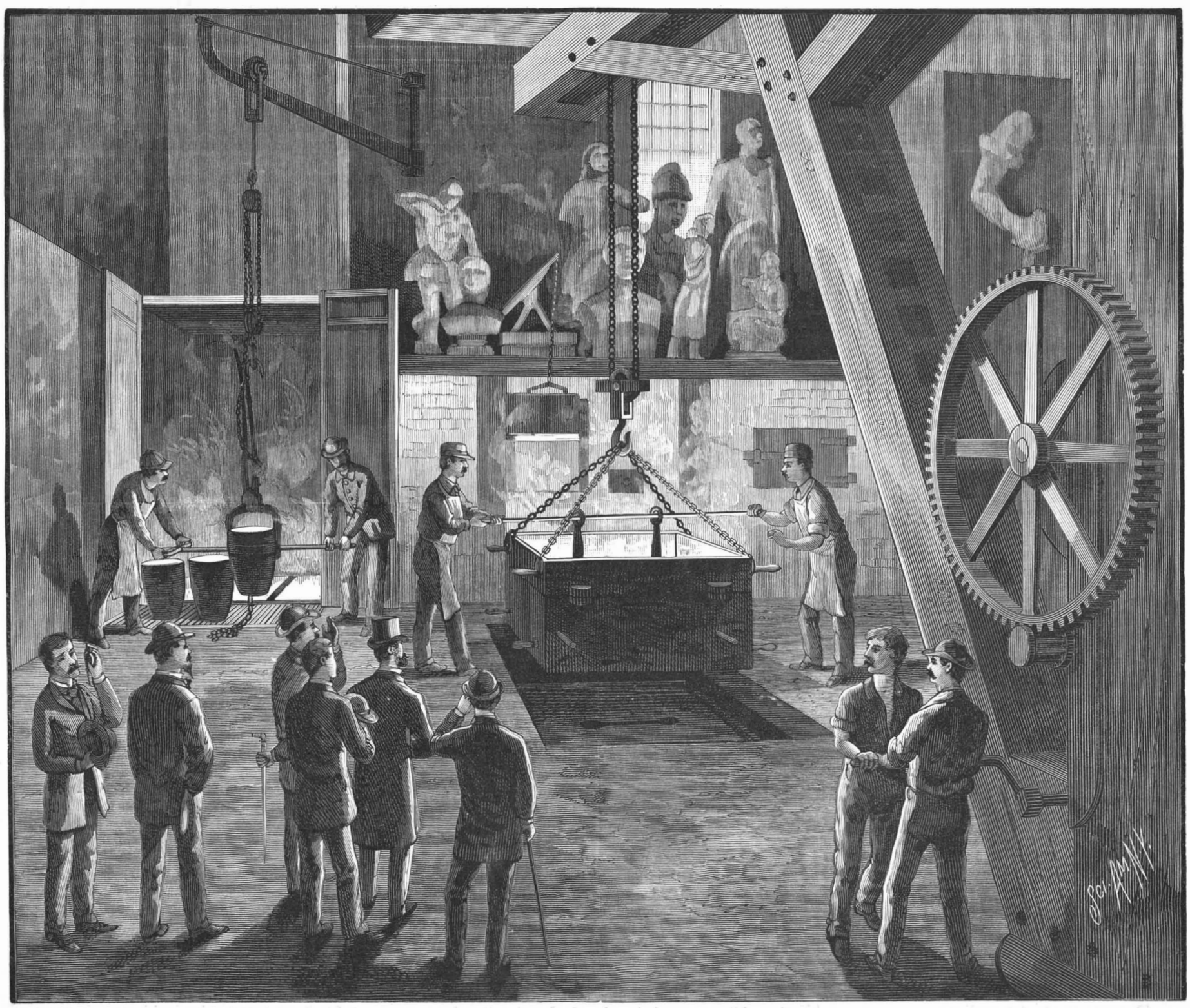

CASTING THE BRONZE BUFFALO'S HEAD FOR THE UNION PACIFIC BRIDGE AT OMAHA.

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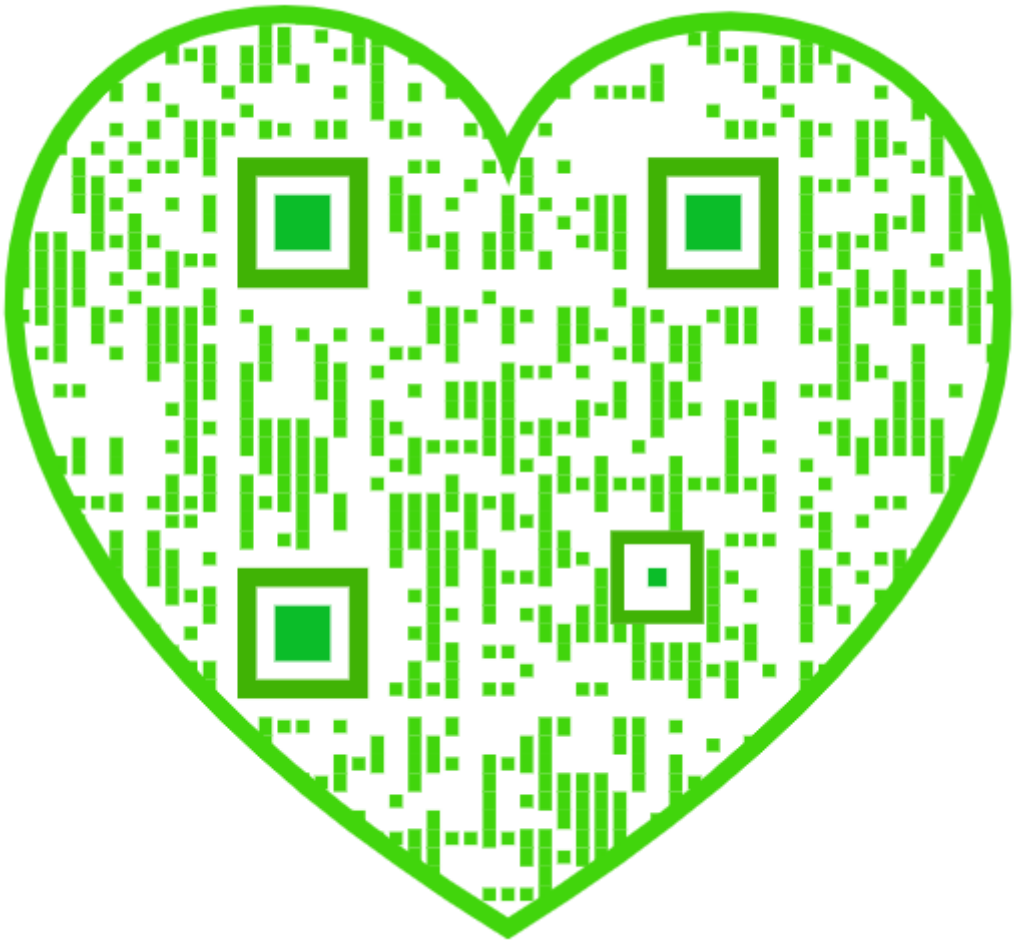

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NEW YORK, SATURDAY, SEPTEMBER 3, 1887.

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ISTHMIAN SHIP TRANSIT.

The interesting question as to a means of ship transit across the American isthmus was discussed at the recent meeting of the American Association at Columbia College, this city. The most important paper on the subject was by Commander Taylor, U. S. Navy, who expressed himself strongly in favor of a canal at Nicaragua, which locality he has visited. His remarks upon the proposed ship railway at Tehuantepec show him to be less familiar with this project; his opinion thereon being directly opposed to that of experienced engineers who have devoted time and thought to the matter. He says the ship railway project at Tehuantepec promises to be as disastrous in its ending as that at Panama. Most engineers and ship builders, he says, doubt the practicability of the project, and fear the sinking of embankments and the racking of hulls of heavily loaded ships. He fears that the earnest belief in this project held by its promoter, the late Mr. Eads, and his past successes, would cause credulous persons to enter into the visionary project.

If Commander Taylor, or any other who may have similar doubts as to the practicability of the ship railway project, will take the trouble to inquire into its details, they will not discover any grounds for their fears. The principal objection to the ship railway scheme would seem to be its novelty. There was a like objection to the employment of a jetty system at the mouths of the Mississippi. The dredge had been used so long on this river that the engineering world had come to look on its use as almost statutory, and though it had never accomplished anything of lasting advantage, other means of clearing channelways, if not based upon dredging, were regarded as hazardous and visionary. Mr. Eads constructed his jetties on his own responsibility, and showed popular expert opinion to be founded in error by permanently deepening the channelways of the passes and making New Orleans once more a sea port.

Commander Taylor's objections to the ship railway scheme may be classed under two general heads: 1st, because of the method of handling ships while *in transitu;* and 2d, because, in his own words, "the cost of a railroad nobody can tell." Now, Commander Taylor, who is a skillful navigator, would not hesitate to put his ship into a floating dry dock, and would look on with complacency while the water was being pumped out of the pontoons and the structure, gradually rising out of the water, lifted her high and dry. He has forced his ship through driving seas without a qualm, as every other experienced sailor has. No one knows better than he that a well constructed ship is practically a girder, specially adapted to bear severe strain. A big steamer in a heavy seaway often rests upon two waves, one under her bows and the other under her stern, while the 'midship section has practically no support from the water; and, again, her bows will be almost out of water and her screw "racing." Her constructors prepared for this, and in putting her parts together they got unity out of multiety. It does not require a knowledge of navigation, neither of mathematics, to discover that a ship laboring in a heavy seaway is called upon to bear a far greater strain than she would be while being lifted out of water in a dry dock, into a cradle, and then wheeled over a level railway. This is so obvious as not to require any mathematical demonstration.

If there be any who do not think so, let them resort to figures. It is not enough to say a thing cannot be done or is impracticable. There ought to be some specific reason, some data or figures, to sustain the assertion. The big iron steamer Amerique ran up on to the New Jersey coast at Seabright some years ago, and after pounding her loaded hull on these sands for a fortnight, lay exposed to the buffeting of winter gales for nearly three months. The wooden ship Lornty, sunk in New York Bay, withstood all the wrenching of the chains passed around her bottom by the wreckers, and was finally brought to the surface unscathed, while the iron steamer Welles City, sunk in the North River, underwent similar treatment in a wrenching tideway, unharmed.

So far as the cost of the ship railway is concerned, it seems surprising that so well-informed a man as Commander Taylor should assert that a ship canal, which must be constructed, for at least a part of its way, through a river filled with rapids and falls, in a country annually visited by floods, may be estimated with more certainty than a railway. Ship canal construction is rare the world over, but so much has been done in the way of railroad building, that it has virtually become a science, and once a careful survey is made of a proposed line, a first-rate engineer will compute the amount of cutting and filling and ballasting and the cost of rails and rail laying with something approaching exactness. Commander Taylor very reasonably looks upon the geographical position of Nicaragua as superior to that of Panama, because ships following the most frequented tracks would save hundreds of miles by crossing the isthmus at the former. For the same reason, Tehuantepec is vastly more convenient than Nicaragua, being hundreds of miles further north; indeed, it is at the extreme upper end of the isthmus, while Nicaragua is not far distant from the lower end. Panama, he truly remarks, is in the zone of calms, in the doldrums, and Nicaragua in the "trades." So is Tehuantepec.

The question of harbors must take a principal part in any discussion of isthmian routes; and though Nicaragua once had a fine harbor at Greytown, it has filled up, and will cost millions to recover even in part, whereas the roadsteads of Tehuantepec call for no unusual skill, no extraordinary outlays, to make safe for ships to ride in.

DUPLICATION OF GOVERNMENT SCIENTIFIC WORK.

It appears that the government is now employing three different scientific corps to investigate and report on one and the same matter, namely, the characteristics of genuine butter and its imitations.

In the first instance, we have the division of microscopy of the agricultural department, represented by Dr. Thomas Taylor and his assistants; then we have the division of chemistry of the same department, represented by H. W. Wiley and his assistants; and lastly the office of commissioner of internal revenue, represented by a chemist and a microscopist, each lately appointed under the oleomargarine law, whose salaries amount to $5,000 a year, the two last being specially appointed for this special work.

Thus we find three distinct and separate corps of scientists, each with costly scientific apparatus, all employed on the same work, and each putting the country to the expense of printed illustrated reports, costing thousands of dollars.

Professor Wiley the chemist is first in the field with a printed report. It is bulletin No. 13 of the agricultural department, division of chemistry, and constitutes a book of 130 pages, and has 12 pages of photogravure illustrations. It is not our purpose now to pass it in critical review, but we may say that it substantially states that the chemical test is the only practical one for distinguishing butter from its imitations, but it admits that the microscope is useful as an adjunct in making the investigations, but he takes pains to belittle Dr. Taylor's microscopical work, by quoting authorities which state that "little dependence can be placed on *any* microscopical test;" and on the subject of the crystals formed by "the melting and slow cooling of butter," which was Dr. Taylor's discovery, and forms the groundwork of all Dr. Taylor's work, Professor Wiley says, "I consider it a much less valuable indication than the simple observation."

If Professor Wiley is correct in this statement, then all Dr. Taylor's work is void and his reports so much waste paper. And yet the government has in the press a costly printed report of Dr. Taylor's work, the Moss Engraving Company having just printed two million pages of photogravure plates to accompany the report, the edition being, we believe, over 400,000 copies.

All this report is devoted to the microscopical aspect of the question, upon which, as we have shown, one official of the same department claims "little dependence can be placed," and all based on a discovery which Professor Wiley says is "not valuable."

Such being the estimation of the work of Dr. Taylor by the chemical division, the public may be curious to know what the microscopical division think of Professor Wiley's report and scientific work.

Dr. Thomas Taylor says he "thinks it would be more creditable in the eyes of the public if Professor Wiley would stick to his own business. The bulletin, in my estimation, is *of no especial value* in its microscopical aspect, because Professor Wiley has not been careful to select types nor observed uniformity in his treatment of the fats."

So here we have two reports on the same subject issued from the same government department utterly at variance with each other, while both are condemned as worthless by the department which has ordered the work and the publication of the reports. We have offered no opinion on the merits of the two conflicting reports, but will endeavor to do so on another occasion. One of them must be false and deceptive, and we can only regret that many thousands of dollars have been wasted on their preparation and publication.

We have yet to hear from the chemist and microscopist of the internal revenue office. We presume that we may look to them for a report of their work on this subject. We hear informally that they are not working in the best of harmony, and that the microscopist first appointed resigned, and was replaced by another; but we trust they are doing good original work, and will arrive at some solution of the question which will be satisfactory to the public and those specially interested.

At the recent meeting of the American Association for the Advancement of Science, Dr. Taylor exhibited, in four large frames, the original photo-micrographs of the crystals of butter and fats, copies of which will appear in the annual report of the Department of Agriculture, now in the press. The crystals of the various fats examined are over a hundred in number, comprising butter derived from various breeds of cattle, under many kinds of feeds. The crystals of fats show specimens taken from many animals, birds, and even the human subject, both in health and disease. It is cer-

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tainly a most creditable exhibit of intelligent work, and will be a decided advance in our knowledge of this subject. It also shows what can be done with the microscope in the hands of one capable of using it to the best advantage.

THE CELESTIAL WORLD.

THE STAR OF BETHLEHEM.

"Where can the Star of Bethlehem be found?" is the oft-repeated question that comes from many quarters. The fact is, no such star is visible in any part of the heavens. An observer with a vivid imagination fancied he had discovered this long-looked-for star, and announced its return in some journal of the day. The paragraph was widely copied throughout the country. The idea pleased the popular fancy, was received with almost unquestioning faith, and the sky was eagerly scanned for a glimpse of the star that once shone over the humble dwelling that enshrined the Redeemer of mankind. Even the peerless Venus was impressed into service, and was firmly believed to be the sacred star once more shining upon the earth after wandering for ages in the star depths.

The history of the so-called Star of Bethlehem is briefly this: Tycho Brahe, a Danish astronomer, discovered, in the year 1572, an apparently new star near Caph in Cassiopea. When first seen, in November, it had attained the first magnitude. It increased rapidly in brilliancy, until it rivaled Venus, and was visible at noonday. It began to diminish in brightness in December, and continued to fade away until the following May, when it disappeared from view.

Forty years later, when the telescope was invented, a small telescopic star was found close to the spot where the wonderful star was seen. It is still there, and is probably the same. It is now classed among variable stars, and is, therefore, liable to blaze forth at any time in the same extraordinary manner. After classifying the star as a variable, the next thing to be done was to find out its period of variability. Astronomical records were searched, and it was ascertained that about the years 1263 and 956 bright stars suddenly appeared near the same quarter of the heavens. It was, therefore, classified as a variable, with a period of about 309 years. Counting back three periods from 956, the exact period being uncertain, the star may have appeared near the time of the Christian era. Some imaginative observer, for this reason, christened it the Star of Bethlehem, and with scarce the shadow of a foundation the name has adhered to it ever since. It is also known as the Pilgrim Star, and among astronomers as the star of 1572.

If the star be a variable, with a period approximating to 309 years, it is now due, and liable to burst forth into sudden brilliancy at any time. No celestial event would be more welcome to astronomers. The scientific world would be wild with excitement over the substantiation of an ingenious theory and the confirmation of its hopes. Its first appearance, its exact position in the heavens, its changes from day to day, would be telegraphed all over the country, and minutely described in the journals of the day. The advent of a comet, spanning the sky from the zenith to the horizon, would be of no account in comparison with the blazing star! Meantime the telescopic star near Caph in Cassiopea shows no signs of any coming disturbance, and observers must wait patiently for developments, remembering that the outburst will be sudden, if it come.

It is generally considered that the extraordinary changes of light in stars like that of 1572 are caused by sudden outbursts of glowing hydrogen gas, which by its own light and by heating up the whole surface of the star causes the immense increase in brilliancy. The spots, faculæ, and rosy protuberances on the sun give some idea, on a small scale, of what may be going on in other suns on a much larger scale. Fortunately, the new or temporary stars observed by terrestrial astronomers number only about twenty-four, an infinitesimal number when compared with the boundless millions of stars that shine with nearly unchanging brightness. The probability is, therefore, small that our sun will be added to the list of blazing stars. He will probably shine for millions of years to come, as he has shone for millions of years in the past, and if observed from other suns and systems will be classed as a variable, with a period of about eleven years, corresponding to the cycle of sun spots.

THE GREAT SUN SPOT OF LAST JUNE.

The solar surface should, according to the sun spot theory, be approaching its most quiescent condition, for it is passing through the stage known as the minimum of sun spots. The condition of the fiery orb, however, does not always conform to the laws laid down. The sun has a way of his own that sets all theories at defiance. An immense spot appeared on his surface on the 7th of June. It was carefully observed by European astronomers during its whole passage across the solar disk. When first seen it was situated a little south of the equator, and its greatest diameter measured 50". It was observed with the naked eye and the telescope, and continued to be visible until the 17th, when it disappeared on the sun's border. The appearance of this enormous sun spot, denoting great activity of the solar force, is specially remarkable as occurring at a time when the sun is passing through the minimum of the eleven-year cycle of sun spots.

Alvan Clark.

One of the great masters of the mechanical arts has passed away. Alvan Clark, the most eminent manufacturer of telescopic lenses in the world, died a little after 3 o'clock on the morning of August 19, 1887. His advanced age had so weakened him that he succumbed to an indisposition that had only affected him for a few days. At the present period, when the subject of manual training is exciting so much attention in educational circles, the lesson of Mr. Clark's life is peculiarly interesting. By his extraordinary technical skill, industry, and patience, he won for himself a fame that was world-wide. In spite of the peculiar field of his work, his fame was not confined to astronomical circles. His name had become a household word.

He was born in Ashfield, Mass., on March 8, 1804. He came of the old Mayflower or Puritan stock. His father was a farmer, and young Alvan received only a public school education. He showed artistic tastes early in life, and possessed a great aptitude for sketching. In 1826 he obtained a position in Lowell, Mass., as designer and engraver for the calico printers in one of the mills. For nine years he kept to this occupation. In 1835 he removed to Boston, and opened a studio on Tremont Street for painting miniatures. His home was in Prospect Street, Cambridge. For twenty years he pursued the profession of artist. He had married on March 26, 1826, his wife being Miss Maria Pease, of Conway, Mass. Their son, Alvan G. Clark, about the year 1844 was a student at Andover, following the course in engineering. The father became interested in the son's scientific studies, and it was at this period that Mr. Clark began the work of his life. According to his own recital, he was thus led to study technical optics:

"My son, Alvan G. Clark, was at Andover, studying to be an engineer. His young mind seemed to be absorbed in telescopes. I was a portrait painter then, and I began to study mechanics and astronomy so as to instruct my boy. We experimented together, and succeeded in making a reflecting telescope. One of the Cambridge professors was much pleased with some instruments we made, and when we suggested to him that we would like to manufacture improved instruments, he gave us great encouragement, and we went ahead."

After succeeding with a speculum, lenses were the next object on which they were to try their ability. The result of their work was so good that, giving up all other pursuits, the father and son devoted themselves to making telescopes. Their reputation grew, and gradually reached England. The Rev. W. R. Dawes, a prominent astronomer of that country, heard of them, and ordered a glass. It reached him in the fall of 1853. This telescope did such fine work that it made their reputation abroad, and many foreign orders were at once received. They began by making six-inch objectives, and their telescopes furnished with these were of wonderfully fine quality. But they gradually increased the size of their work, and in 1860 received an order for a lens of 18 inches diameter. It was in this year also that their present factory was built. Up to that period 15 inches was the diameter of the largest lens in the world. The new order came from the University of Michigan. The civil war prevented its acceptance by the university, and it was sold to the Astronomical Society of Chicago, Ill. By its use, on the night of January 31, 1862, he and his son, Mr. Alvan G. Clark, discovered the companion of Sirius. In consequence of this discovery, the Lalande medal was awarded by the French Academy of Sciences. When in its final position, in which it was placed in 1862, this great glass showed twenty stars hitherto unseen in the nebula of Orion.

During the war the firm were kept busy making binocular field glasses for the use of the Federal officers. In 1870 a contract with them was authorized by the United States Congress for a telescope for the Naval Observatory at Washington. Work was begun upon it in January, 1871. In 1872 the glass was tested with most remarkable results, yet more work was put upon it, and it was only in 1873 that it was mounted. It is considered almost perfect. A duplicate of this glass was ordered by and made for Mr. J. S. McCormick, of Chicago, to be presented to the Washington and Lee University of Virginia. About the same period they began to make a yet larger lens for the Russian observatory at Pulkowa. This instrument cost the Russian government $33,000. It has a clear aperture of 30 inches, a focal distance of 45 feet, and a magnifying power of 2,000 diameters. The general increase in diameter of the firm's lenses may now be thus summarized in inches: 6, 8¼, 9½, 12. 15½ (Astronomical Society of Chicago), 18½, 23 (Princeton College), 26 (Naval Observatory and J. S. McCormick), and 30 (Pulkowa Observatory). For the last instrument the Imperial Academy of Science gave a vote of thanks, and the Czar of Russia a gold medal.

The great telescope of 36 inches diameter, for the Lick Observatory of the University of California, is greatest triumph. The price was placed at $50,000. The main portions of the lens were completed about a year ago. The photographic lens is still unmade. It was nearly completed with the others, when, during an experiment, it was destroyed. Mr. Alvan G. Clark is now in Europe to secure a new disk for another attempt.

It is said that Alvan Clark had never seen a lens ground. All his skill he acquired in his own workshop. He was extremely modest, preferring to talk of his artist life rather than of his optical triumphs. To those who visited his shop he used to exhibit with pride his miniatures. These were very fine, and had he continued as an artist, there is little doubt that renown would have been acquired by his brush. Later in life he returned to portrait painting as a recreation. Up to a recent period he was in daily attendance at his shop.

Amherst College in 1854, Princeton in 1865, and Harvard in 1874 gave him the degree of A.M. His wife and two sons, Alvan G. and George B. Clark, survive him. Last year the sixtieth anniversary of his wedding was celebrated.

He made several scientific discoveries of importance, inventing a double eye piece and devising a very valuable and accurate method of measuring small celestial arcs. It is a matter of congratulation that his sons have so long been associated with him, as the extinguishment of the Clark establishment would be a misfortune to science.

Metallic Thermometers for Hot Drying Chambers.

The object of this instrument, says the *Bulletin de la Societe Industrielle de Mulhouse*, devised by Mr. H. Grosheintz, is to indicate the average temperature of a hot flue or drying chamber, in which it is necessary for success in the drying of delicate fabrics that the process of drying should take place very regularly and at an exact temperature.

The thermometer consists of a brass wire, the expansion and contraction of which supply the indications of temperature, and a system of levers outside the drying chamber, by means of which the range of action is multiplied. Thus the variations in temperature may be read more plainly. The apparatus is at work in the establishment of Messrs. Scheurer, Rott & Co., in a drying chamber 74 feet long, between walls. The wire is one twenty-fifth inch or one millimeter in thickness, and is 79 feet in length, stretched from outside to outside of the walls, passing through openings in them. One end is fastened to the outside of one wall, and the other end is connected to a system of levers outside the other wall, by means of which the variations in the length of the wire are multiplied sixteen times.

Taking the expansion of brass wire at 0·18 per cent of the length, between the temperatures 32° and 212° F., the extension on 79 feet of length is $79 \times 100 \div 0{\cdot}18 = 1{\cdot}685$ inches, and $1{\cdot}685 \times 16 = 27$ inches is the range of the pointer between the given extremes. The scale is graduated in accordance with a mercurial thermometer, placed within the chamber at about the middle of the wire. The metallic thermometer is very sensitive. For instance, when the two thermometers, metallic and mercurial, read 60° C., or 140° F., at the beginning of an operation, before the pieces to be dried can be passed in, the metallic thermometer falls 9° or 10°, while the mercurial remains stationary. The metallic thermometer has been at work for three years continuously, and gives great satisfaction.

Manufacture of Glucose with Nitric Acid.

The originators of this process, A. Seyberlich and A. Trampedach, use nitric acid for the saccharification of starchy or amylaceous matter. To eliminate, then, the nitric acid from the solution of glucose thus obtained, water saturated with sulphurous acid is added in such quantity that the sirup smells of this gas. The mixture, heated rapidly, brings about the decomposition of the nitric acid. At the expense of the oxygen contained in this acid the sulphurous acid is rapidly converted into sulphuric acid, and nitric oxide is evolved. The reaction is so perfect that no trace of nitric acid can be found with Schönbein's reagent. On heating to boiling, the excess of sulphurous acid is expelled from the saccharine solution. This last operation must be conducted rapidly, and with an abundant supply of steam, so that the saccharine solution shall not remain long in contact with the sulphuric acid formed, as otherwise the sugar would be liable to decomposition. The solution of glucose obtained is neutralized with carbonate of lime, and made alkaline with alkaline carbonates evaporated and crystallized. The crystalline mass contains only a small quantity of sulphate of sodium, and can be at once washed.—*Zeitschrift fur die Chem. Indust.*

FOUR kittens, born at Narragansett Hotel, in New London, were bound together like the Siamese twins by a ligature at the abdomen. The cords were in the form of two triangles joined at the apex, the four ends connecting the kittens, with a space of 1½ inches between.

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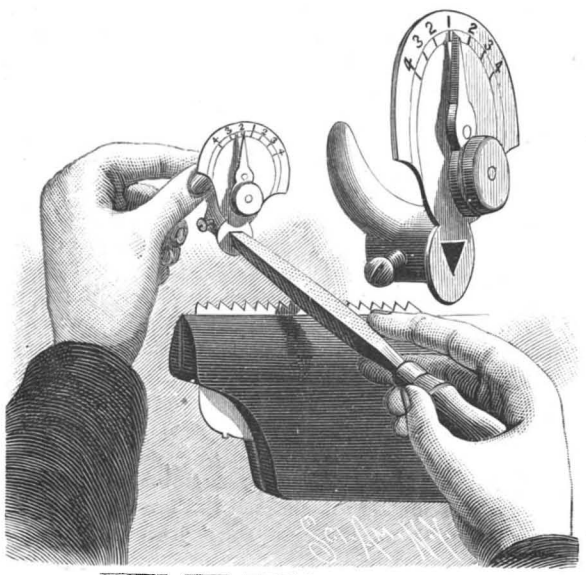
A CONVENIENT DEVICE IN SHARPENING SAWS.

The illustration herewith shows a novel file attachment, for which a patent has recently been allowed. In filing saws by hand it is very difficult, even after years of practice, to so hold the file that after sharpening the saw the cutting edges of all the teeth will be in parallel lines, because the angle at which the file is held to the teeth is likely to be slightly varied in



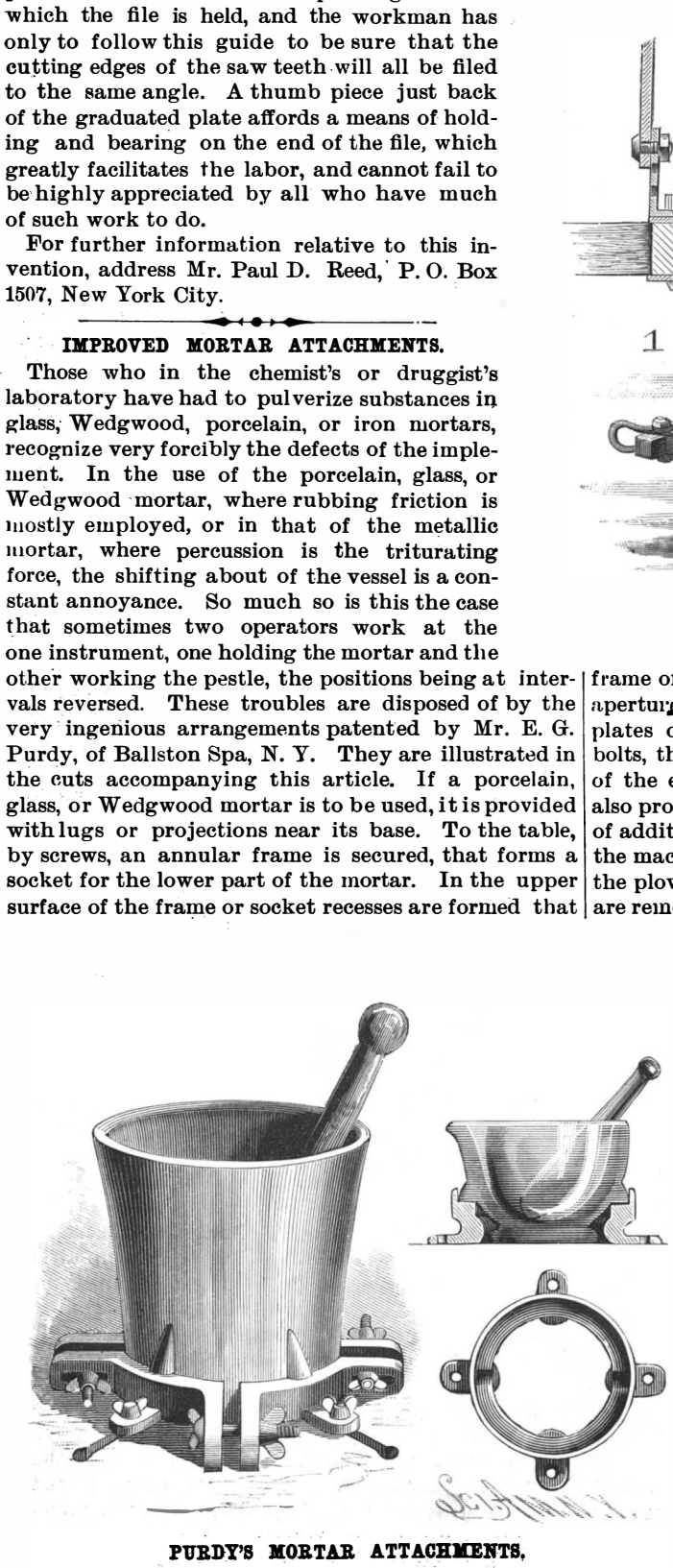
COOK'S SAW FILING ATTACHMENT.

different portions of the work. This invention affords a means of overcoming such difficulty by providing an attachment, to be connected with the file point, carrying a graduated plate having a gravity pointer. The graduated plate is bent slightly backward, so that its index is always in plain sight of the operator, and, at whatever angle it is desired to sharpen the teeth, the pointer indicates the corresponding inclination at which the file is held, and the workman has only to follow this guide to be sure that the cutting edges of the saw teeth will all be filed to the same angle. A thumb piece just back of the graduated plate affords a means of holding and bearing on the end of the file, which greatly facilitates the labor, and cannot fail to be highly appreciated by all who have much of such work to do.

For further information relative to this invention, address Mr. Paul D. Reed, P. O. Box 1507, New York City.

IMPROVED MORTAR ATTACHMENTS.

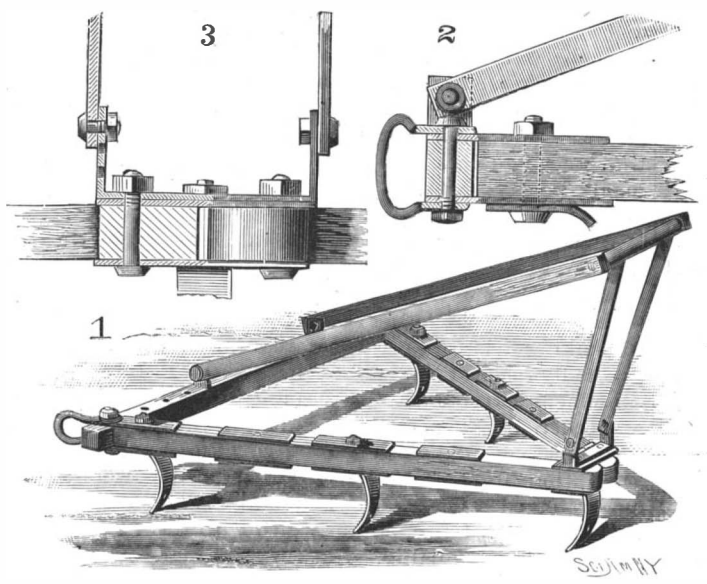
Those who in the chemist's or druggist's laboratory have had to pulverize substances in glass, Wedgwood, porcelain, or iron mortars, recognize very forcibly the defects of the implement. In the use of the porcelain, glass, or Wedgwood mortar, where rubbing friction is mostly employed, or in that of the metallic mortar, where percussion is the triturating force, the shifting about of the vessel is a constant annoyance. So much so is this the case that sometimes two operators work at the one instrument, one holding the mortar and the other working the pestle, the positions being at intervals reversed. These troubles are disposed of by the very ingenious arrangements patented by Mr. E. G. Purdy, of Ballston Spa, N. Y. They are illustrated in the cuts accompanying this article. If a porcelain, glass, or Wedgwood mortar is to be used, it is provided with lugs or projections near its base. To the table, by screws, an annular frame is secured, that forms a socket for the lower part of the mortar. In the upper surface of the frame or socket recesses are formed that correspond to the lugs upon the body of the vessel. Dropped into this receptacle, the mortar cannot shift about, and cannot rotate or twist on its vertical axis. The operations of pulverization can be conducted with far greater rapidity and comfort than when the mortar has to be embraced by one arm, or at the least held by one hand of the operator. For the metallic mortar a similar socket is provided. This is made in segments that are fastened together by bolts passing through lugs. The segments are secured to the table by bolts with thumb nut, working in a strip of iron provided with a slot, the strip of iron being screwed to the counter, table, or other support. The mortar is provided with lugs fitting into notches in each segment. As these notches weaken the segments, the holding-down ears, through which the bolts already alluded to pass, are placed opposite to the notches, so as to act as a re-enforcement. The circle of segments can be screwed up so as to embrace the bottom of the mortar with great rigidity, and the socket thus constituted affords an admirable basis to resist the shocks of the pestle. The lugs upon the mortar prevent it effectually from turning. The adjustable socket will operate with glass, Wedgwood, or porcelain mortars equally as well as with iron or metallic mortars, and the "annular frame" is likewise adapted for iron or metallic mortars, as well as for glass, porcelain, or Wedgwood, and *vice versa*. Each of these devices is the subject of a separate patent.



PURDY'S MORTAR ATTACHMENTS.

AN IMPROVED CULTIVATOR.

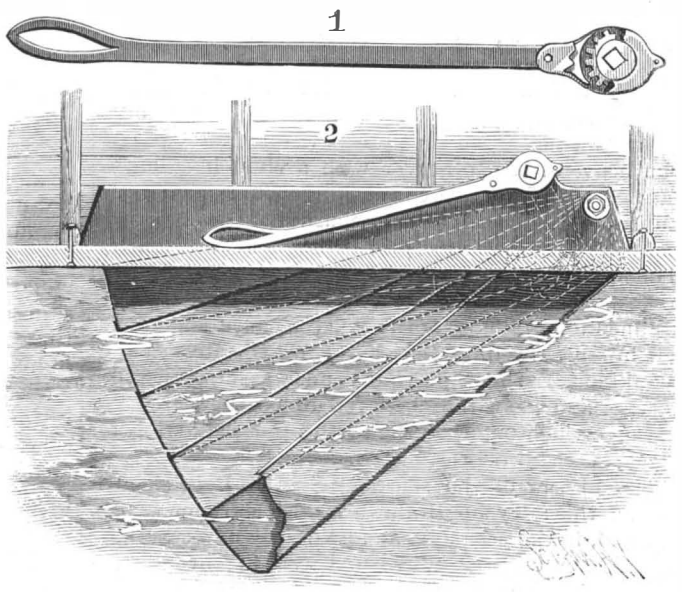
A cultivator which provides for the employment of a good many plow shovels, and in which the distance between the plows may be regulated or adjusted at will by very simple means, is illustrated herewith, and has been patented by Mr. James M. Sutton, of Bryan, Brazos County, Texas. The front bar of the triangular frame of the cultivator has at each end several vertical apertures, through which and aligned apertures in plates on the front ends of the side bars are passed bolts, thus extending or diminishing the distance apart of the end plow standards. Each of the side bars is also provided with vertical apertures for the insertion of additional plow shovels. When it is desired to use the machine merely to lay off the rows for sowing, all the plows except those attached to the front standards are removed, and a wheel or roller is attached to the rear end of the machine, of which Fig. 3 gives a detailed section, showing the attachment of the braces to support the handle bar, Fig. 2 showing the forward end of one of the side bars. With this cultivator, the plows may be easily adjusted to plow close to or far from the rows, as desired. No singletree is required, but the draught animal may be hitched to hooks in clevises that are connected to the ends of the front bar, this also making the cultivator very easy to lift around when plowing, as most of the weight will be on the draught animal.



SUTTON'S CULTIVATOR.

A FOLDING CENTER BOARD FOR SMALL BOATS.

A center board which can be readily fixed in the bottom of a boat, folds into a very small space, and can be easily manipulated, is shown in the accompanying illustration, and has been patented by Mr. Thomas R. Brough, of Gananoque, Ont., Canada. The casing is of galvanized iron, 27 inches long, 4 inches high, and ⅝ inch thick, with a flange around the base perforated every two inches for screws, with which the case is secured to the keel or keelson, a strip of soft rubber packing rendering the joint water-tight. Inside the box, on a loose sleeve, are swung five blades, the lower one double and hollow, closed front and bottom, and

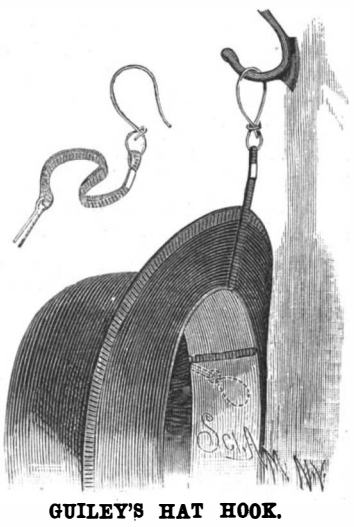


BROUGH'S CENTER BOARD FOR VESSELS.

partially at the rear. When the board is extended, this hollow blade stays the others, and when closed incases them, discharging any floating dirt through the opening in the rear. Through an upward extension of the casing passes a rock shaft, with a central squared portion, to which is fitted a forked arm extending down in the case. The blades, swinging on a common pivot, have slots through which passes a roller carried by the forked arm, the slots varying in their angle of inclination in such way that the blades are opened out like a fan, or folded, by turning the rock shaft which operates the forked arm, the slots being so made that when the board is fully returned to place it will be locked there, as the roller has passed over a center. A specially devised wrench for operating this rock shaft is shown in Fig. 1. It is about 18 inches long, with a cog wheel having a square in the center to fit on the shaft, and a double pointed pawl pivoted in the rear to engage at the operator's will with either point, whereby the board can be expanded or contracted by a very slight motion of the wrench. When sailing with the board extended, if any obstruction is encountered, the board will close into the case without motion being imparted to the wrench, which will act as a stop to prevent the board from dropping more than half way, but nothing more, except in the hands of the operator. Quite a number of these center boards have already been for some months in use, and their convenience and efficiency are highly spoken of.

A SIMPLE AND INEXPENSIVE HAT HOOK.

A quickly applied and neat little attachment by which hats may be readily suspended from the back of a chair or other support is shown in the accompanying illustration, and has been patented by Dr. Augustus H. R. Guiley, of No. 413 Center Street, South Easton, Pa. The device consists of a hook of brass wire, which may also be readily made into a loop by catching its open end into a smaller loop, the latter being attached to a ribbon or cord, which has on its other end a little piece of wire bent in the form of a staple, for conveniently attaching it to the hat. This little wire staple is passed between the hat body and the sweat band, and the two side parts of the staple are then bent outward, so as to lie next the stitching which connects the sweat band to the hat body. It is thus concealed from view, and where it cannot hurt the head of the wearer. In adapting the device to ladies' hats the crown lining may serve to place the hook behind instead of the sweat band, or a piece of ribbon sewed to the hat to form a slip pocket for the hook.



GUILEY'S HAT HOOK.

FACE POWDER.—Wheat starch 12 lb., powdered orris 2 lb. Mix together, and add attar of lemons ½ ounce, attar of bergamont and cloves each 2 drachms.

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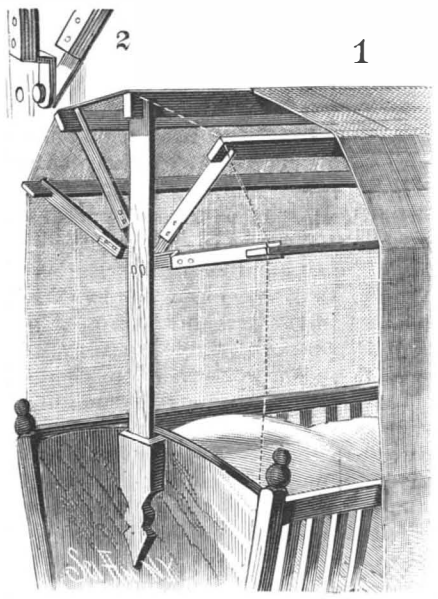
AN IMPROVED CANOPY-SUPPORTING FRAME.

A cheap and durable frame for supporting canopies, mosquito netting, etc., and which may also be used for shelter tents and awnings, is shown in the accompanying illustration, and has been patented by Messrs. Andrew F. Tracy and James Winchell, of 405 Grand Avenue, New Haven, Conn. To the end standards



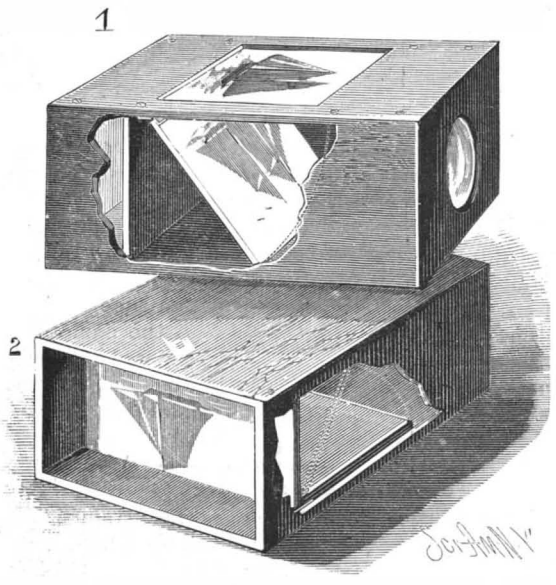
TRACY AND WINCHELL'S CANOPY FRAME.

are pivotally connected folding arms, these arms having end straps to adapt them to fold together, as shown in Fig. 2, and the upper ends of the standards and of the folding arms are recessed to receive a ridge pole and longitudinal strips, connected together by tapes or straps, and this frame, extended as shown in the illustration, is in position to support the netting. The frame may be readily taken apart for snug stowage, or the arms upon one side may be folded up when it is desired to make or dress the bed. For use as a shelter tent or field awning the lower ends of the posts or end standards should be sharpened, that they may be easily driven into the ground.

AN IMPROVED FINDER FOR PHOTOGRAPHIC CAMERAS.

The wonderful advance in the sensitiveness of the photographic film, now so generally furnished in what is known as the gelatine dry plate, has caused the art and practice of instantaneous exposure to be largely followed. For its more successful practice a new auxiliary, termed a finder, is found to be very convenient. The camera having been directed so that the passing object shall traverse its field, the finder is placed upon or affixed to the instrument so that its field is in register with that of the camera. The ground glass of the camera is then removed and the plate holder with plate inserted and the slide of holder withdrawn. Of course there can be no further vision through camera. In this finder, however, all is seen, and that, too, exactly as present in camera on the uncovering of lens; and as the position of the moving body becomes that which is wanted, exposure is made with a certainty of like position on camera plate.

Among the qualities desirable in a finder, aside from its correctness, are, first, that it be of such dimensions that the size of field is sufficiently large for easy observation; second, that for convenience of carriage it is no larger than necessary. The form used, when the



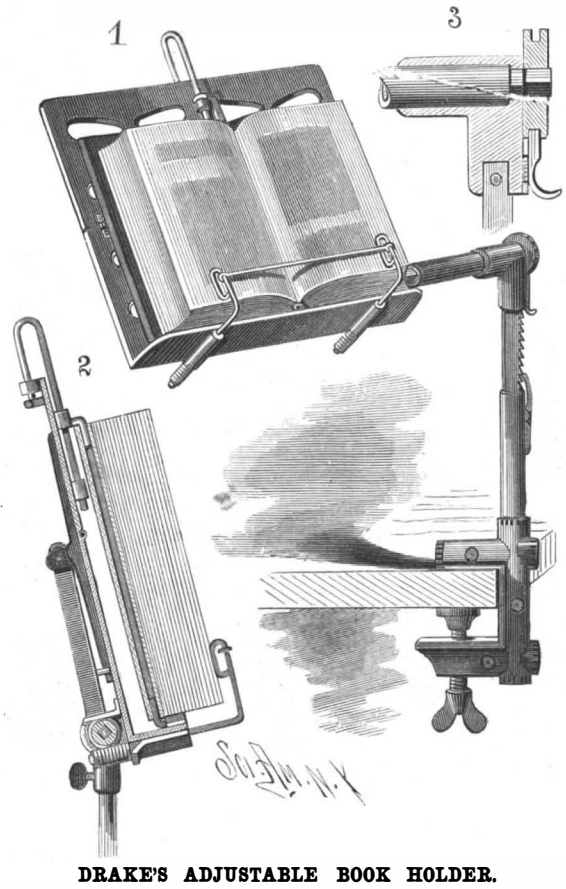
HIGGINS' FINDER FOR PHOTOGRAPHIC CAMERAS.

camera is stationary or tripod, is that in which the screen of the finder is in the same plane with that of the camera, viz., perpendicular or upright.

Where the camera is held in the hand, or on the lap, or under the arm, as for the so-called detective, and other rapid exposures, it is needful that the screen of the finder should be in a horizontal plane at a right angle to that of the camera, and that the view be thrown upward upon it, by a mirror or other reflecting surface or prism. Such arrangement enables the operator to look down conveniently upon it, and the delineation, moreover, is now seen non-reversed. In the finder we illustrate we have one that is practical and serviceable. It has been patented by Dr. J. J. Higgins, of New York City. Its size, while fully sufficient, is such that it can be placed inside the camera when closed, or carried in the pocket.

AN IMPROVED ADJUSTABLE BOOK HOLDER.

A book holder, designed to accommodate books of varying dimensions, and to hold them to suit various positions of the reader, and which, when not in use, can be folded up into small compass, is shown in the accompanying illustration, and has been patented by Mr. Peter A. Drake, of Shell Lake, Wis. The U-shaped base clamp is provided with tubular sockets whereby the main holding rod is held upright from either a vertical or horizontal support, each of the sockets having catches, allowing the rod to be turned when desired. This rod is mainly tubular, and in it is mounted a square ratchet bar, forming an extensible post, which can be adjusted and held at any length by means of a pawl. On the upper end of this ratchet bar is an elbow adapted to receive a tubular rod, within which is a square sliding rod, connected with the outer end of which is the folding skeleton frame of a book rack. Connected with the frame are attachments to hold the leaves open in place, or which may be simultaneously operated to permit the turning of a leaf, the attachments being easily adjustable independently of each other to suit the opposite parts of the book



DRAKE'S ADJUSTABLE BOOK HOLDER.

when open. In our illustration, Fig. 2 is a sectional view of the book rack with a book held open, and Fig. 3 shows the adjusting device for preventing the arm supported by the main holding rod from turning. With this holder a book can be securely held to suit the convenience of the reader in almost any situation, even when lying in a recumbent position.

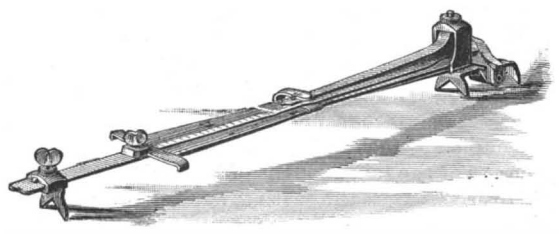
The Panama Canal.

The project of damming up the Chagres with 26,000,000 cubic meters of earthwork, accompanied by a culvert large enough to admit the issue of a stream gauging 400 cubic meters per second, and needing for its course a cutting nearly as wide and deep as that required for navigation, depends, among other things, for its accomplishment on the forebearance of earthquakes. One tremor of the ground would bring down the whole mighty structure. Altogether, M. De Lesseps and his shareholders are in a terribly awkward plight. They cannot very well abandon works which have cost over fifty millions of money, and yet they cannot with prudence go forward. They have two alternatives, and only two, before them. One of them is to sell the whole thing for, say, twenty millions to the Americans—who are quite willing to buy the concern—and the other is to suspend M. De Lesseps, and to put in somebody who will personally superintend the works. Who that somebody ought to be we have, we confess, no idea.—*British Trade Journal.*

To restore faded ink on parchment, etc., the Bodleian Library, at Oxford, has long employed hydrosulphide of ammonia, a solution of which is spread in a thin layer over the writing, by means of a camel's hair pencil.

AN IMPROVED AXLE GAUGE.

A gauge which will answer the requirements of a great variety of work in axle setting, and in which the number of adjustments is reduced to a minimum, is shown in the accompanying illustration. A "dish" rule, graduated in parallel lines an eighth of an inch apart, is attached to the main bar, and the "spoke" rule is graduated in inches and fractions thereof. On the spoke rule is a notch, or mark, to which, when adjusted, the pointer must point. Near by is an oversprung plate, on which is a center or normal line, also a left and right gather mark, to one of which a brass pin on pointer must point when setting for "gather." The automatic head throws out the ques-



McQUARRY'S AXLE GAUGE.

tions of size and taper altogether, and actuates the pointer merely by the weight of the gauge. Only two measurements are required to set for "plumb spoke," namely, length of spoke and amount of "dish." All axles whose central portions are arched up or jogged down, forward or backward, can be readily set with this gauge, with a saving of time and avoidance of error, if the workman follows the very simple directions.

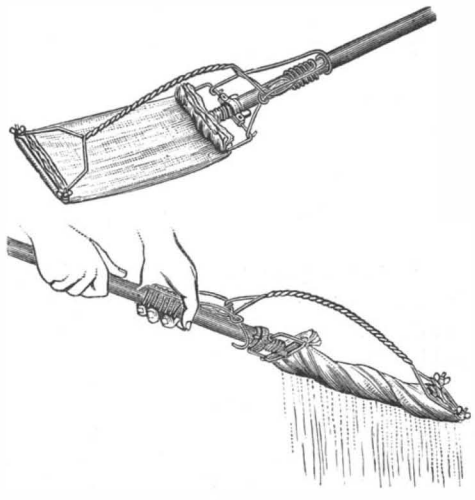
This invention has been patented in the United States and Canada by Mr. H. McQuarry, Allandale, Ontario, Canada.

Orson S. Fowler.

On Thursday, August 18, after a short illness, the well-known advocate of and lecturer and writer on phrenology died at his home near Sharon Springs, N. Y. He was born in Cohocton, Steuben County, N. Y., on October 11, 1809. He worked his way through Amherst College. There he was a classmate with Henry Ward Beecher, and it is said that a book given him by the great preacher turned his attention to phrenology, in which he was destined to do his life-work. In 1838 he started the *Phrenological Journal.* In 1843 the deceased, who had been associated in business with his brother and Dr. Nathan Allen, of Lowell, Mass., added to the firm Mr. Samuel R. Wells. The firm name now became Fowler & Wells, which still flourishes. It has acquired great fame for the publication of phrenological literature. In 1865 Mr. Fowler left the firm and entered the lecture field, and traveled all over the country descanting on his theme. He was one of the notabilities of the city, and the author of a number of books on phrenology and allied subjects.

AN IMPROVED MOP ATTACHMENT.

A simple and readily applied mop attachment has been invented by Mr. Calef Mansbarger, of Albany, N. Y., and is shown in the accompanying illustration, a patent for the device having recently been allowed. The body of the attachment is preferably constructed of a single piece of wire, bent at the upper end to form a coil adapted to be slid over the mop handle. The attachment, thus encircling the mop handle, detachably engages its head and clamps the free end of a



MANSBARGER'S MOP ATTACHMENT.

cloth held in the mop head, whereby the cloth may be wrung while held in a flexible horizontal position, or drawn up over the mop head parallel with the handle. The cloth may also be drawn tightly over the mop head to facilitate cleaning in corners, one of the figures showing the mop with the attachment ready for ordinary use, and the other while the water is being wrung out without applying the hands to the cloth.

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A GREAT BRONZE CASTING.

(*Continued from first page.*)

plugs in position, to fill it with melted bronze, and by withdrawing the plugs to allow the metal to run down through the gates into the space between mould and core.

This plan was carried out. The flask, lined with clay, was lowered upon the mould. Its lining, before the casting took place, was heated by a charcoal fire to avoid chilling the metal. Then, when the plugs were solidly in place and all seemed ready, the reverberatory furnace was tapped and the melted bronze allowed to run into the reservoir. Three crucibles full of additional metal were added to the bath. These were plumbago or graphite crucibles, holding nearly four hundred pounds apiece. This gave a total of six thousand pounds of the finest bronze. The plugs were then withdrawn, and in seventeen seconds the white hot bronze had disappeared in the recesses of the mould. The entire operation of filling the reservoir and casting only occupied fifteen minutes. On that short period the success of the four months of labor depended.

For over ten days the casting was left undisturbed, so as to cool perfectly. It was then withdrawn from the pit, and cleaned with scratch brushes and washed over with ammonia. The horns were dropped into their sockets and screwed fast. The seam marking their junction with the head was calked or hammered, so as to be imperceptible, and the head was ready for its destination.

When it is remembered that no two important pieces are cast on the same plan, as modifications are continually required to meet the exigencies of the different shapes, the skill required to fill the profession of a bronze founder can be realized. It is said that the practice of fifteen years is needed to train a man so that he can execute all kinds of work. A failure is irreparable. Small holes can be filled, but if any large part fails in casting, the work must be begun again. This illustrates the responsibility involved in casting so large a piece. When cleaned it represents some four thousand pounds of metal, an excess of two thousand having been provided in the bath. In building and bracing the mould, and in all the appurtenances of the casting, metal, mould, etc., about sixty thousand pounds of material were used.

The casting was executed at the Favy Foundry, Forsyth Street, New York, on August 9, 1887.

BRONZE BUFFALO HEAD FOR UNION PACIFIC BRIDGE AT OMAHA.

The American Institute of Christian Philosophy.

This society, which has just held its sixth anniversary and its tenth summer school of science and philosophy, should be better understood and appreciated by the public. The Institute was originated by a number of prominent American scientists at the suggestion of the Earl of Shaftesbury. It is designed to accomplish in this country results analogous to those achieved abroad by the Victoria Institute of Great Britain. Its president, from the first, has been Rev. Charles F. Deems, D.D., the accomplished pastor of the Church of the Strangers, in New York City. Among its vice-presidents may be named Bishop Bedell, ex-president Noah Porter, of Yale University, Hon. T. F. Bayard, Rev. Joseph Cook, of Boston, Professor Alexander Winchell, of Ann Arbor, and other men of mark. The secretary is the noted botanist, Professor C. M. Davis, of Bloomfield, N. J., and the treasurer is William Harmon Brown, of New York City. The gift of fifty dollars makes the donor a member for life; while annual members pay but five dollars a year for the privileges of the Institute, namely, the use of the library, tickets to the lectures given under its auspices, and copies of all official publications. The entire membership at present is exactly 484, including members from the United States and Canada, representing all of the various branches of scientific investigation, all of the learned professions, and every phase of religious belief.

The Institute must not be regarded as in any sense sectarian or exclusive; nor is it a school of theology. On the contrary, theological discussions are expressly interdicted as foreign to the legitimate aims of the society. These aims, as set forth in the constitution, are as follows: To promote the full and impartial investigation of all scientific or philosophical questions, especially in their relation to religion; the association of men of science, in order to consider the mutual relation of the several branches into which science is divided; the examination of seeming contradictions and conflicting hypotheses, with reference to final causes and the fundamental principles of philosophy and of faith; and finally, the publication of lectures and addresses for the promotion of scientific and religious culture. This latter work is done by means of "Christian Thought," a bi-monthly magazine published in New York City.

Monthly meetings of the Institute are held in this city. The annual meetings and the summer schools of science and philosophy are usually held at some place of summer resort. This year the place of meeting was at Key East, near Ocean Grove, N. J. An invitation has been received to meet next year at Round Lake, N. Y. The interest taken by those who attend these meetings is deep and earnest, although there is not as large an attendance as might be inferred from the long list of members.

The following papers were read and discussed during the summer session of 1887, from August 17 to 25: "Certain Aspects of Modern Skepticism," by Lyman Abbott, of New York; "History, a Demonstration under the Moral Law," by James F. Riggs, of Bergen Point, N. J.; "Paul's Psychology," by Isaac F. Hopkins, president of Emory College, Oxford, Ga.; "Physical Theories of the Mind," by J. T. Bixbee, of Yonkers, N. Y.; "Bishop Berkeley's Philosophy," by C. F. Deems, of New York; "Subterranean Scenery," by H. C. Hovey, of Bridgeport, Conn.; "History and Philosophy of Sunday Legislation," by A. H. Lewis, of Plainfield, N. J.; "Some Aspects of Theistic Logic," by Professor A. T. Ormond, of Princeton, N. J.; "Christian Evolutionism and its Influence on Religious Thought," by Professor D. S. Martin, of New York; and the closing address by Thomas Hill, ex-president of Harvard University, was on "The Absolute, a Person."

The custom is to devote an hour to the free criticism of each paper, to which the author has the privilege of reply. A glance at this year's programme suggests the question if philosophy does not crowd out the more practical sciences, and also if, as an American institute, there ought not to be more papers from other places than New York and New Jersey. But these defects, if they are so considered, can easily be remedied. The general aim and scope of the society are manifestly wholesome, and the organization is worthy of appreciation and encouragement.

The Sprinkler in Theaters.

A practical demonstration of fire extinction in a theater was given recently in the new one which is being built in London for Edward Terry. In this theater special precautions are being introduced, in order to guard against the spread of fire should an outbreak occur. Each part of the house has two exits, and the whole, including the roof, is constructed of concrete and iron, no wood being used in the auditorium except for the doors and windows. The woodwork before and behind the curtain will be coated with Sir Seymour Blane's fireproof paint. The fire-extinguishing arrangements consist of a complete system of hydrants, placed in the best positions both before and behind the scenes, while the whole of the stage and flies, both above and below, is commanded by a system of overhead sprinklers, governed by valves at the stage door and capable of immediate use. The sprinklers are fixed on pipes which are in direct communication with the water company's mains, the water being at about ninety pounds pressure. At the recent experiments a large fire was made on the middle of the stage, that being the least likely point at which a fire would occur. The flames rose some twenty-five feet high, when the signal was given to the fireman at the stage door, who instantly opened the valves and admitted water to the sprinklers. The result was that the fire was quickly extinguished, the sprinklers being set at an angle which commands the whole of the stage as well as the flies. There will be forty-five sprinklers in all, and thus, while the auditorium is fireproof, it was shown that the stage and flies could be deluged with a perfect cloud of water at few moments' notice. The exhibition was witnessed by various notable persons and by Captain Shaw of the London Fire Brigade. It will be observed, says *Fire and Water*, that the device is simply the application to a theater of the automatic sprinklers so well known in this country. We have often wondered why they were not adopted in theaters, hotels, and other places where crowds of persons assemble, for they would certainly give confidence to all who knew of their presence, and in an emergency many lives might be saved at the cost of merely a severe drenching. An unexpected shower bath would certainly be preferable to roasting alive in a burning building.

[In the above case, we observe the sprinklers are not automatic, but it would be better if they were. We think the time has come when laws should be passed requiring all owners of tenement, manufacturing, and mercantile buildings to put in the automatic sprinklers. In default of this, let the taxes on such buildings be increased.]

Origin of the Letter X in Mathematics.

The letter x, used to designate the unknown in equations, has been explained as a modification of the letter s used by the Arabs; but Government Engineer Ritter, in a note to *La Nature*, shows that such is not the case. He says:

"In writing the as yet unpublished biography of the immortal inventor of modern algebra, Francois Viete, Maitre des Requêtes of the King's Palace, Counselor of State, and personal friend of Henri IV., and in translating his mathematical works, I have necessarily had to extend my researches in algebra. I am, therefore, able to explain to your readers the origin of the letter x in equations. Ancient algebra, before Francois Viete (Ἀριθμητικά of Diophantus, *Aljebr wâh-mukâbalah* of the Arabs, *Ars magna* of Cardan, and *Ars rei* or *Ars cossica* of the Italians), was reduced to the solution of numerical equations. In Diophantus, the unknown (ἀριθμος, 'number') is represented by the letter ς′ with the numeral index (′). In the Arabian authors that I have been able to consult, the calculations are always written in all letters, and the unknown is designated by an Arabic word that has been translated as *res*, *cosa*, the 'thing.' And, says the learned Dr. Nesselmann, the Arabs are so consistent in the application of this rhetorical method that they do not once employ a numeral sign in their texts. . . .

"Francois Viete, in his introduction to arithmetic by symbols, substituted the literal for the numerical equation, and he thus succeeded in establishing modern algebra and in discovering the relations that exist between the given and the unknown in equations of different degrees. He represented the former by the capital consonants of the Latin alphabet (B, C, D, etc.), and the latter by the first small letters of the alphabet (*a*, *b*, *c*, etc.) Later on, Descartes changed this notation, and designated the known quantities by the first small letters of the alphabet (*a*, *b*, *c*, etc.), and the unknown by the last (*x*, *y*, *z*). . . . As in France, especially, the history of mathematics is not much known, it will certainly be for the first time that most of the readers of *La Nature* will read the name of one of the greatest geniuses that have rendered our country illustrious, and whose place is in the same rank with that assigned by posterity to Archimedes, Descartes, and Newton."

An Exhibition of Postage Stamps.

An international exhibition of postage stamps is now in progress at Anvers, says a foreign exchange. One exhibitor, a Mr. De Beer, has alone sent thither a million stamps. Among the varieties to be seen at the exhibition is the oldest postage stamp in existence, belonging to the 18th century, and a postal card that made the tour of the world in 80 days. The latter belongs to a Haarlem schoolmaster, who would not part with it at any price.

It seems that there are no less than 600,000 postage stamp collectors in the world, 375,000 of whom are Americans, 200,000 are Europeans, and 25,000 belong to other parts of the world.

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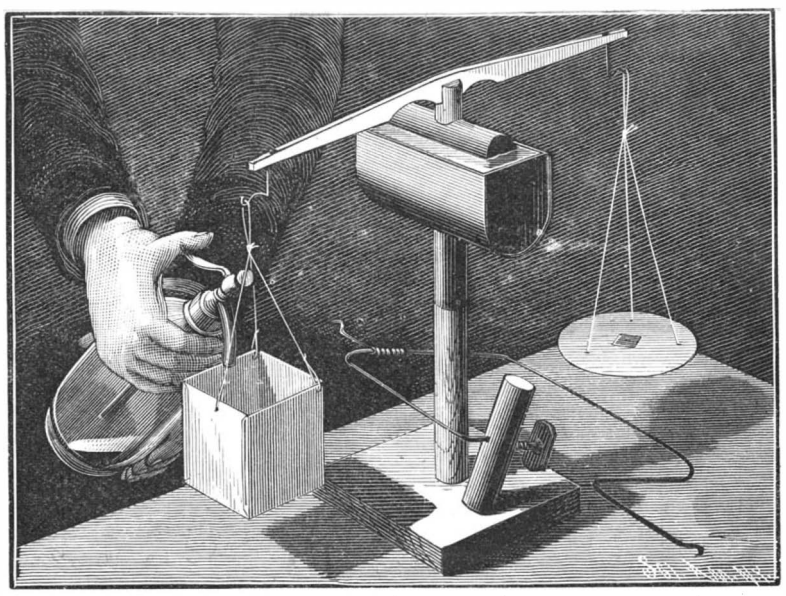
THE FLOATING BALANCE.

T. O'CONOR SLOANE, PH.D.

An interesting example of the laws of the equilibrium of floating bodies combined with a well-known illustration of the specific gravity of gases is afforded by the apparatus illustrated in the cut. It is essentially a balance in which the ordinary fulcrum is suppressed and replaced by a floating cylinder. As the resistance offered by water to the slow movement through it of a floating body is almost nothing, it follows that a very sensitive balance may be thus constructed. The experiment in which it is represented as employed is the weighing of carbonic acid gas.

The balance beam is made of a thin strip of wood. A piece of printer's "furniture," used in setting up pages, is a good material for this purpose. It is set into a short pin, also of wood, which is driven into a wooden cylinder. The latter should be an inch in diameter and three or four inches long. The pin should be inserted half way between the ends. Into the cylinder directly opposite the pin a wood screw is inserted. A disk of lead is soldered to its head. This acts as a handle by which to turn it, and also as additional counterpoise. It is for the end of maintaining a sensitive but at the same time stable equilibrium that the weighted screw is used.

At each end of the beam, hooks are arranged as shown for attachment of the pans or other receptacles. They are made of iron or brass wire, and are firmly secured to the beam. They are carried downward so as to bring them in line with a point slightly above the axis of the cylinder.



THE FLOATING BALANCE.

For the weights, a scale pan of mica may be used. If carbonic acid or nitrous oxide gas is to be weighed, a light paper box, three or four inches on each edge, takes the place of a second pan. Thread is used to suspend them.

A tin reservoir of the shape indicated has a socket soldered to its bottom. By this it is held on a standard as shown. The upright piece should also pull out of the base, so as to make the whole portable. For weights or counterpoises, little bits of wire, tin, and tinfoil may be employed.

The cylinder is introduced into the empty reservoir and water is poured in until the cylinder floats up near the level of the upper edge. The entire surface of the cylinder should be well moistened. The balance now has to be brought into equilibrium. This is done by hanging the pans in place, and by using weights or the counterpoises we have mentioned. When in equilibrium, it is examined as to its stability. If it is sensitive to one-seventh grain (10 milligrammes), it is good enough. If not, the screw under the water must be screwed further in.

By repeated trials the sensitiveness can be accurately adjusted. To allow the beam sufficient motion, it is well to cut out two pieces on each side of the cylinder. As it is very important that it should be rigid, these notches must not be made too deep. When to be used in weighing a gas, the box is carefully counterpoised, and the balance is made as sensitive as possible. If now the box is filled with carbonic acid or nitrous oxide gas, that end of the balance immediately descends, although nothing is visible.

Another form of the balance beam is shown lying at the foot of the apparatus. For wooden beam and supporting pin a bent wire is substituted of the form indicated. By careful bending and sliding, the two pan-hooks can be brought to the proper level, and the experiment performed with quite as good satisfaction as in the other form.

Carbonic acid gas may be made by pouring vinegar upon baking soda. A pickle bottle or preserve jar answers for the operation, and in a few seconds it can be filled with the gas. By careful manipulation this can be poured out like water into the box suspended on the balance beam. Nitrous oxide, or laughing gas, is made by heating nitrate of ammonia. A great deal of water is evolved along with it. If to be used in the experiment, it must be caught by displacement of air, as it dissolves in water, thus precluding the use of the hydraulic trough.

Finally, a very ready source of carbonic acid gas is suggested in the illustration. After a mineral or soda water siphon has been exhausted of its liquid contents, it still contains a considerable quantity of gas. By inclining the siphon to one side, so as to keep all water away from the end of the glass tube, the gas may be drawn off by opening the valve. The best plan is to fill a pickle jar or other bottle from the siphon, and thence to pour the gas into the counterpoised box. If the siphon is used directly, the force of the escaping gas will tend to agitate the balance unless the cock is opened with extreme care. In all cases the experimenter must be on his guard, and allow no water to enter the box.

Creatures We Breathe.

The supporter of the doctrine that the particulate ingredients of the atmosphere are the chief cause of the insalubrity of cities will find much to sustain his contention in the brief but suggestive paper contributed by Dr. Frankland to the current number of the *Nineteenth Century*. From the facts presented, the proposition might easily be maintained that "a man carries with himself the elements of his own destruction." Many arguments of a seemingly valid sort may be educed from hygienic and antiseptic systems, calculated to prove that a germless atmosphere would be far more profitable to the majority of mankind than the atmosphere with which we have at present to be contented; and this notwithstanding the somewhat contrary position which Dr. Frankland takes at the commencement of his paper, for he thinks it would require but little persuasion to convince most of us that air without organisms would be undesirable indeed. He proceeds to illustrate this view by a reference to the great utility and value of one micro-organism at least, the yeast fungus, which is so widely and universally distributed, and whose disappearance from the breathing medium would cause us to "forego those numerous, complex, and much appreciated pleasures which are derived from the consumption of alcohol in its various forms."

For our own part, we believe there is already sufficient evidence to warrant a belief that the presence of micro-organisms in the respiratory fluid is very undesirable; while we confess at the same time that their exclusion would be practically impossible. Undoubtedly, many of the germs in the air we breathe are for the most part harmless in their nature, though it is probable that even the innocuous varieties may require a slight expenditure of energy on the part of the human organism to neutralize the effect of their activities, since it is hardly likely that the act of destruction of a bacterium is unattended with the employment of some kind of force, and we know that the active protoplasm of living bodies is capable of destroying bacteria. Indeed, the theory implied in these considerations may be expanded.

We may conceive, for example, that deterioration of health by a general weakening of the whole body might be the cause of many diseases, not so much by the agency of the mere debility as by the circumstance that the deterioration afforded the opportunity for the growth and development of organisms which, under the ordinary circumstances of good health, would have been quickly destroyed by the inherent vitality of sound tissues. The experiments of Pasteur and Tyndall, and the observations of Miguel and Frankland, bear abundant testimony to the existence of a law which may not be expressible in such definite terms as that the number of microbes in the atmosphere varies inversely as the square of the distance from human habitations, but which, nevertheless, forcibly reminds one of this physical law. Pasteur exposed twenty flasks containing putrescible substance in the open country of Arbois, and found that eight became turbid or contaminated with microbes. Of twenty exposed in the lower heights of the Jura Mountains, only five became affected, while of twenty others exposed at the Montanvert, close to the Mer de Glace, at a height of 6,000 feet, only one flask developed microbes. Miguel, by observations made at Montsouris, in different seasons of the year, has shown how the distribution of microbes is dependent on the surroundings.

Frankland, employing a more recent and more accurate method, has shown very clearly that the maximum number of micro-organisms is to be found in the hottest months of the year. Thus, in a volume of air equal to about two gallons (ten liters) collected on the top of the Science and Art Department buildings at South Kensington, at a height, therefore, of some 70 feet from the ground, and so removed from any local disturbance of the air, he found that in August the number of micro-organisms exceeded 100, while in January there were but 5. There was a gradual rise in numbers from May to August, after which the fall in number was much more sudden. In the country the number of atmospheric micro-organisms was very appreciably smaller; and the more remote the place of observation is from houses, and from the frequented thoroughfares of traffic, the dust of which is always rich in refuse organic matter, the freer does the air become from suspended microbes.

In reading Dr. Frankland's paper one cannot but be struck with the remarkable concomitant variation between the number of micro-organisms and the unwholesomeness or wholesomeness of the places investigated. Every medical man knows the value of mountain air and of a sea voyage, and it is only in these places that the atmosphere can be said to be free from micro-organisms. The interiors of railway carriages are, as we all know, apt to become foul, but Dr. Frankland's estimation that more than 3,000 organisms were found to be falling on the square foot in one minute while the train was passing half way between Cambridge and London, one window of the compartment being shut and the other only open four inches at the top, gives a mathematical expression to the fact, which, if any were wanted, is sufficient explanation of the fatigue of a journey, without invoking the aid of the theory of nerve vibration to account for the prostration which many suffer after a prolonged ride in the train. In point of numbers, however, the atmosphere of a barn where flail thrashing was in operation puts the railway compartment in the shade, for there were no less than 8,000 organisms falling on the square foot in one minute. The injurious effect of theaters and crowded places of amusement would find a sufficient explanation in the yield of micro-organisms, without taking any account of the diminution of oxygen or the increase of carbonic acid. At a conversazione at Burlington House the number of organisms reached 432 per ten liters of air.—*Lancet.*

A Sea Telephone.

A dispatch from Cincinnati, Ohio, says: At Fernbank, ten miles from this city, are the workshop and laboratory of Harvey B. Cox, a young electrician, who, though known to but few here, is attracting the attention of scientists and electricians in this country and Europe by his inventions, in which he is as prolific and ingenious as Edison. His latest device is a trumpet to be used for telephoning at sea, on which he has been working for some months. The invention is the outgrowth of his discovery of the great distance an echoed or reverberated sound will carry and the discovery that speaking trumpets, if made to give the same fundamental note, would vibrate and produce the phenomenon known in acoustics as "sympathy." With this trumpet, conversation in an ordinary tone of voice was carried on between persons four and a quarter miles apart. People siting at their windows or on their porches a mile away conversing in an ordinary tone could be distinctly heard, and in a couple of instances they were told the nature of their conversation and admitted that such had taken place. By listening to the whistle of a train, and tracing it to and beyond Fernbank to Lawrenceburg, Ind., it was found that the instrument has a well-defined range of twenty-six miles; that is, a loud sound like a locomotive whistle or the rumbling of a train can be distinctly heard at a distance of thirteen miles in every direction. Conversation was readily carried on between two gentlemen on high hills on opposite sides of the Ohio River, about four and one-half miles apart. Tests made on the water showed that the trumpet was even more available than on land. The instrument will be patented as soon as perfected. A name has not yet been chosen for it. Mr. Cox has a great many other curious and valuable devices, both electrical and mechanical, but none as curious as his sea telephone.

Carbonic Acid Gas as a Fire Extinguisher.

The fiery, untamed soda-water tank, which has chiefly distinguished itself since the advent of hot weather this year by bursting and killing or maiming its attendants, has made a new departure, says *Fire and Water*, and now appears in the role of a most efficient extinguisher of fire. Some days ago at Louisville, Ky., a boy carried a lighted candle into the cellar of a drug store, and in some unexplained way set fire to a vessel full of varnish, which blazed up through a grating in front of the building as high as the second floor. Before, however, the flames could gain headway in the building, the heat had melted the lead pipe connected with the newly charged soda fountain, and the flames were instantly extinguished.

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THE FIRE APPARATUS OF PARIS.

When a house takes fire, it frequently happens that the exits that would permit of the surprised inhabitants' escape are rendered inaccessible by smoke or fire. We then, as in the case of the burning of the Opera Comique at Paris, see unfortunate persons making frantic appeals from the high windows of the edifice, while others, who have taken refuge on the roof, would not fail to lose their lives were it not for life-saving ladders. There are several styles of these ladders. The one most used in the regiment of Paris firemen is Bayley's, and is the one that is here illustrated.

This ladder is not only designed for saving life, but also for supporting the hose when it becomes necessary to throw water into the upper parts of a burning building.

In the saving of life the ladder is used either as a means of descent or merely to allow the firemen and their apparatus to reach the upper stories. The height reached by this ladder is 88 feet, which about corresponds to the eighth story. When it is upright and not extended it reaches the third story.

The Bayley ladder, which has been used for several years by the Paris fire department, is kept at the engine house upon a truck that is always ready to have horses harnessed to it and to start with its men at the first signal. The truck, which is a two-horse one (Fig. 1), consists of a fore and hind carriage, a movable pole, four wheels, two cheeks of wood, a seat, and two rack brakes. The ladder is maneuvered through ropes and pulleys. It is made of wood, and consists of three sections, which slide within one another. Each section consists of two uprights, each strengthened internally by an iron cable, and provided with twenty-eight rounds, twenty-seven of them of wood and one of iron. Each section is provided with two iron cables, with stretchers designed to prevent flexion.

The first section is held by two stretchers fixed to the upper part on the one hand and to the back of the frame on the other. Two rollers fixed at the upper part of the third section facilitate the sliding of the end of the ladder against the wall.

The sliding sections are maneuvered through winches fixed to the extremities of a windlass. The accessories kept in a box in the truck comprise three 100 foot ropes for steadying the ladder during high winds, a rope used in tilting the ladder, keys for tightening nuts, etc.

The truck, with its ladder and its set of eleven men, weighs 9,250 lb. The truck alone weighs 4,488 lb., and the ladder 3,070.

The ladder is maneuvered by a sergeant, a corporal, and eight firemen.

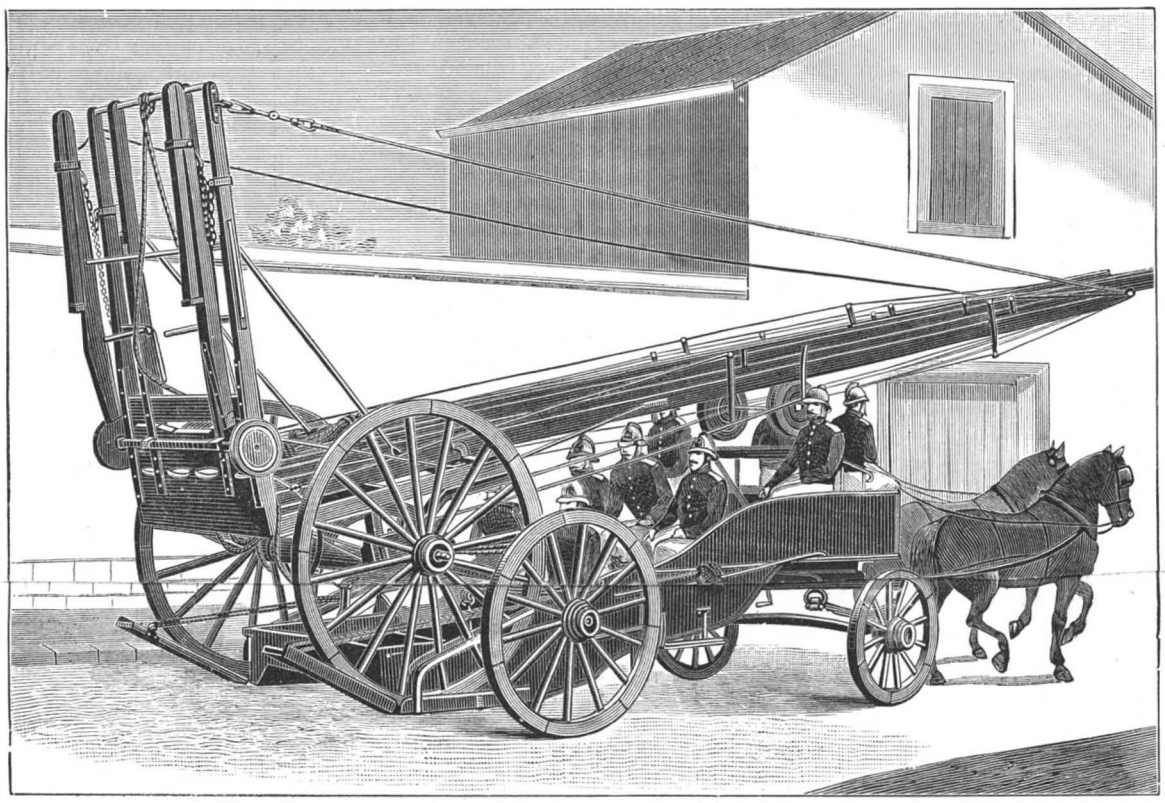

Fig. 1.—BAYLEY'S FIRE LADDER ON ITS TRUCK.

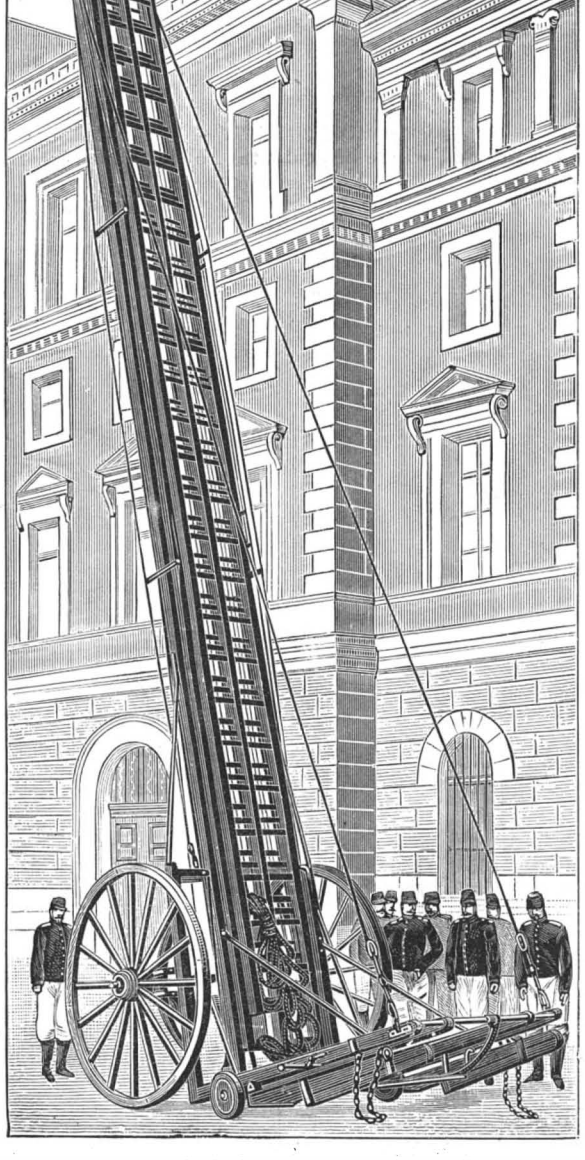

Fig. 2.—THE LADDER UPRIGHT.

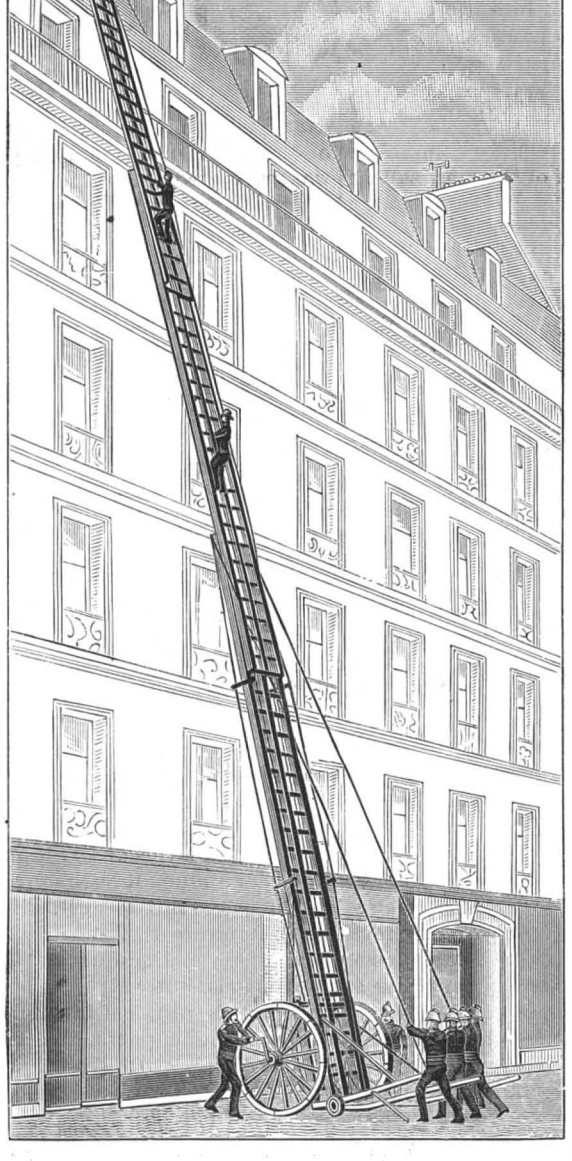

Fig. 3.—THE LADDER EXTENDED.

Fig. 2 represents the ladder standing upright, and Fig. 3 shows it drawn out to its full length.

Among the other ladders that are most used by the Paris fire department, we may cite the Shand-Mason one, which is of rolled and hammered iron, and the Lieb one, which is in four sections. In addition to these large ladders, we may mention the ordinary hook one, which is provided with but a dozen rounds, which is maneuvered by hand, and which can be used for mounting from one story to another through the windows.—*La Nature.*

The Portable Water Tower.

Among the modern devices brought into use for the important purpose of conquering large fires is the movable water tower. In construction it is simply an upright tube by means of which the streams from three or four engines are united in one, carried to a considerable height, and poured in a miniature deluge upon the very focus of the flames. It has been in use in the New York Fire Department about nine years. Its inventor, Abner Greenleaf, of Baltimore, had spent many years previously in perfecting his plan. The machine has now passed beyond the stage of experiment, and its value as an auxiliary force in the conflict with fires in great warehouses has, in the estimation of all, become fully established. For the needs of the metropolis it may be considered as indispensable. The water tower is a portable standpipe which, for convenience of carriage, is in four sections. The lower section, fourteen feet and six inches long and nine inches in diameter at the base, is fixed upon a heavy iron platform mounted on a four-wheel carriage. This section, when not in use, lies horizontally on a framework, and in that position looks like a long mounted cannon. Two other sections of the pipe, twelve and nineteen feet respectively, are carried in racks at the side of the platform. These gradually diminish in size, and the fourth section is a pipe in immediate connection with the nozzle. The sections are joined together by large couplings similar to hose couplings. The entire length is fifty feet. When less than this is required, but a part of the sections are mounted. The nozzles in use are six in number, and range from 1⅔ to 2⅔ inches, the 1¾ being that most frequently in service.

When the tower is to be used, on a special call or third alarm, it is placed in front of the burning building, and on account of the exposure to danger in that position, the horses are immediately removed. The platform is made level by jackscrews. The sections are firmly put together. An elevation of thirty feet is secured by coupling the twelve-foot section to the lower one, and this is sufficient when the building is not more than fifty feet in height. When the situation so requires, the entire length of all the sections is brought into use. The nozzle having been screwed on, and the swivel guy ropes adjusted, the tower is raised with a hand wheel, and made secure in a perpendicular position. All this is done in about fifteen minutes. The water connection is then made. To the four inlets in the suction pipe can be attached the discharge pipes of four different engines, although generally but three are used. The water from the several engines is concentrated into one volume in the tower, and forced in a solid, rushing stream into the center of the fire. Through the mechanism employed, the nozzle is under perfect and easy management. The stream of water can be thrown into any part of the building, and places are thus reached to which access would otherwise be impossible. By means of the swivel pipe attachment, invented by Assistant Chief Bonner, of New York, the power is doubled. The water tower works well for all heights up to 75 feet. When buildings exceed this height, the fire department sees good reasons for insisting that the upper stories should be made absolutely fire proof.

The *Insurance Critic* says: For the materials embodied in this account of a useful and valuable invention for extinguishing large fires, acknowledgment is due to the *Fireman's Herald* of New York, which adds the further information that the New York Fire Department has three water towers, two of which are in active service while the other is kept as a reserve. On a corner building two towers are sometimes used. Illustrations of this invention were published in the SCIENTIFIC AMERICAN of August 9, 1884.

PARISIAN FIRE LADDERS.

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AN ALLEGED PERPETUAL MOTION.

Perpetual motion is, to many inventors, what the "will o' the wisp" is to the traveler. It is always in sight, but never quite within reach. One of the favorite schemes for securing the desired end involves the use of permanent magnets, and the only impediment to the realization of a machine for creating power is an insulator of magnetism. With inventors of this class of machines it has always been a great "if;" but now, if we are to believe certain reports, the great "if" has been annihilated, and the force of permanent magnets has been rendered available by the discovery of an insulator of magnetism, which, as we are told, consists of "chemical and mineral substances," but regarding the nature of these substances we are uninformed.

We have secured a picture of the machine, in which an insulating septum of the "substances" is employed to cut off the attraction of a permanent magnet, and thus secure the rotation of a wheel arranged within the field of force of a permanent magnet. This machine is the invention of Mr. H. S. Pullman, of Rockville, Conn., who has exhibited it in the city of Hartford to crowds who have been enabled to witness the wonderful performances of the machine at the expense of ten cents per head.

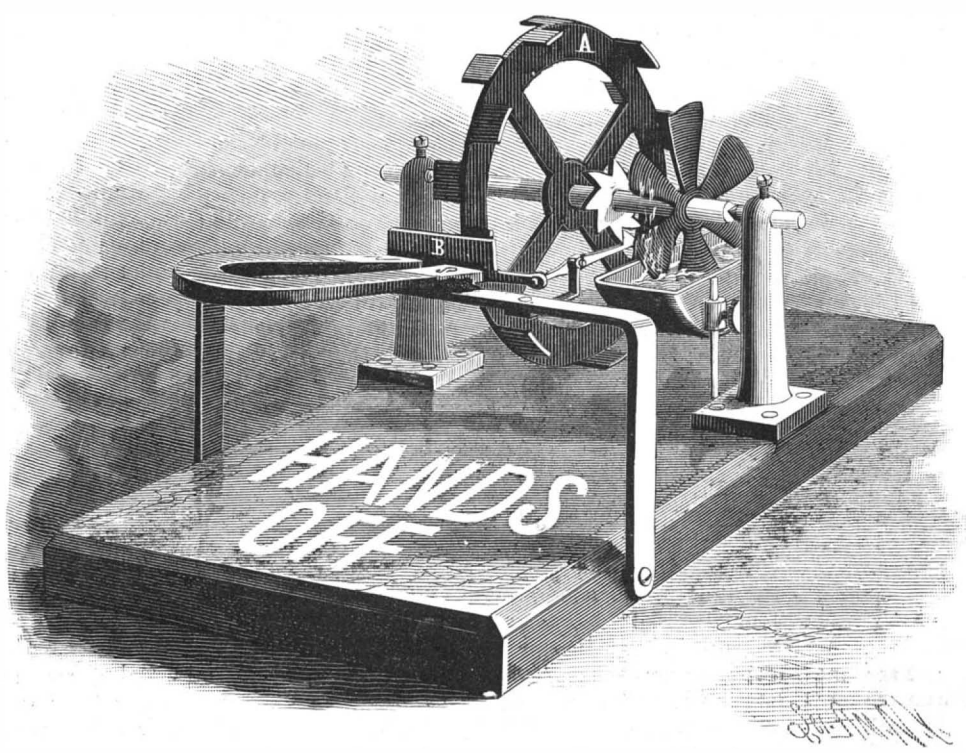
The simple fact of the machine being exhibited under such circumstances would seem to cast a shadow on its genuineness, for, if it is really a power-creating machine, the inventor might realize millions from patents for his invention where he receives only mills in the dime show business; however, the machine has the credit of moving apparently by power created within itself. It has been seen in motion by Mr. W. H. Goldsmith, city editor of the *Hartford Times*, to whom we are indebted for several points in regard to it; and Prof. Luther, of Trinity College, was promised the opportunity of testing the machine, but the inventor, with his machine, like the Arab, "folded his tent, and as silently stole away."

The machine is a wonderfully solid-looking affair for the amount of power produced by it, the thickness of the base and the diameter of the columns supporting the main wheel being apparently altogether out of proportion to the other parts. To an incredulous person these features might be suggestive of a spring motor contained in the base, and mechanism for conveying the power from the base through one of the columns to the motor wheel; and, further, one of the most salient features of the apparent deception is the legend upon the base, which is also suggestive of hidden parts.

To the base are secured two standards provided with centers, upon which are mounted the main shaft of the machine, carrying the motor wheel, A. The wheel is made of sheet iron, with teeth formed in its periphery, and bent alternately in opposite directions. Upon the shaft are also mounted a star wheel and a propeller wheel. The star wheel is arranged to tilt a lever, which carries at its extremity a plate, B, of brass coated with the "chemical and mineral substances" which make it an insulator of magnetism. The permanent magnet is supported by a U-shaped bar, with its poles near the wheel, A, and opposite the path of the insulating plate, B. The propeller wheel, turning in a cup of water, serves to equalize the motion, and thus prevent the machine from running away with itself and committing self-destruction.

We have never seen, nor have we before heard, of an insulator of magnetism, but, supposing it to be an entity, the machine illustrated seems to be poorly adapted for its application.

When one of the projections of the motor wheel approaches the horseshoe magnet, the insulating plate, B, is pushed up between the magnet and the wheel by the action of the star wheel, and as soon as the projection passes the magnet, the lever slips off from one of the points of the star wheel, allowing the insulator to drop, when the magnet will attract the next projection in order, and when near the magnet the insulator will be pushed up as before, and again dropped down, and thus the rotation of the wheel, A, is supposed to continue forever.



AN ALLEGED PERPETUAL MOTION.

IN breaking the ground in a place near Kincardine, Ont., the other day, a skeleton, which to all appearance is that of a wild boar, was found. All the bones, including the tusks and teeth, were in splendid condition, though it is thought they have been lying there for one or two hundred years.

SPENCER FULLERTON BAIRD.*

BY MARCUS BENJAMIN.

The high rank among living naturalists so long held by the distinguished secretary of the Smithsonian Institution makes it eminently proper that he should receive a place in our gallery of American scientists, and at present the time is most opportune, for within a few days the news of his death has flashed through the country.

Spencer F. Baird was born in Reading, Pa., on February 3, 1823. He was sent, at the age of eleven, to a Quaker boarding school in Port Deposit, Md., and a year later to the Reading Grammar School, after which he entered Dickinson College, Carlisle, Pa., where he was graduated in 1840.

For several years afterward he devoted his attention to studies in general natural history, making long pedestrian excursions for the purpose of observing animals and plants. In 1841 he made an ornithological excursion through the mountains of Pennsylvania, walking four hundred miles in twenty-one days, and doing sixty miles between daybreak and rest on the last day. During the following year his pedestrian trips covered more than 2,200 miles. The specimens collected at this time for his private cabinet of natural history became later the nucleus of the museum connected with the Smithsonian Institution.

Meanwhile he studied medicine, and in 1842 attended a course of lectures at the College of Physicians and Surgeons in New York, but, did not graduate. He received, however, the degree of M.D. *honoris causa* in 1848 from the Philadelphia Medical College. In 1845 he returned to Dickinson College as professor of natural history, and a few years later became also professor of chemistry. His lectures included physiology to the seniors, geometry to the sophomores, and zoology to the freshmen.

He accepted the appointment of Assistant Secretary of the Smithsonian Institution in July, 1850, on the urgent recommendation of George P. Marsh, and thenceforth continued as its principal executive officer, becoming in May, 1878, on the death of Joseph Henry, its secretary and official head.

His duties in this connection were exceedingly arduous, and nearly all of the scientific development of the Institution was under his immediate charge. Indeed, his genius for organization made itself apparent from the outset.

The Department of Exploration was placed under his authority from the beginning, and his annual reports constitute the only systematic record of the government explorations ever prepared. During the decade of 1850–60 he devoted much time to enlisting the sympathies of the leaders of government expeditions in the objects of the Institution, supplying them with all the appliances for collecting, as well as with instructions for their use. In many instances he organized the natural history parties, named the collectors, employed and supervised the artists in preparing the plates, and frequently editing the zoological portions of the reports. The specimens brought back to Washington were intrusted to his care. These with his own collection and those of the Wilkes exploring expedition, brought to the Smithsonian in 1842, formed the beginning of the National Museum, now the finest in this country.

It has been no slight task to organize a museum such as that now in existence in Washington, and the brain that planned its details was that of Professor Baird.

According to G. Brown Goode, its assistant director, and since January 1, 1887, in full charge of the museum, "there have been three periods in the history of the museum. At first, it was a cabinet of the results of research. When, in 1857, the Smithsonian assumed its custody, it became also a museum of records. Since 1876, the idea of public education has been predominant."* Besides the usual routine work incidental to the office of assistant secretary, Professor Baird organized the system of international exchanges which has since become one of the leading features of the Institution.

The most conspicuous, and perhaps the most valuable, of Professor Baird's scientific work dates from his appointment in 1871, by President Grant, as Commissioner of Fish and Fisheries. The duties of this office, as originally defined by Congress, were "to prosecute investigations on the subject, *i. e.*, of the diminution of valuable fishes, with the view of ascertaining whether any and what diminution in the number of the food fishes of the coast and lakes of the United States had taken place, and, if so, to what causes the same is due; and also whether any and what protective, prohibitory, or precautionary measures should be adopted in the premises, and to report upon the same to Congress." But the undertaking expanded as the work progressed, until it is now tenfold more extensive and useful than at first. At present, it includes: 1. The systematic investigation of the waters of the United States, and the biological and physical problems which they present. 2. The investigation of the method of fisheries, past and present, and the statistics of production and commerce of fishery products. 3. The introduction and multiplication of useful food-fishes throughout the country, especially in waters under the jurisdiction of the general government, or those common to several States, none of which might feel willing to make expenditures for the benefit of others.

His work in this department has received universal recognition. At the request of the United States government, he was present as advisory counsel at the Halifax Fishery Commission, held in 1877, and at that time prepared an essay on fish culture, into which he threw all of the wealth of his vast knowledge and experience on this subject. The manuscript has recently been put in the printer's hands, and is now in course of preparation for publication.

*For the biographical details of this sketch I am principally indebted to G. Brown Goode's analysis, published in "Bulletin of the U. S. National Museum, No. 20." (Washington, 1883.)

*The story has been well told by Ernest Ingersoll, in the *Century* for January, 1885, under title of "The Making of a Museum."

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In 1878 he received the silver medal of the Acclimatization Society of Melbourne, in 1879 the gold medal of the Société d'Acclimation of France, and in 1880 the first honor prize of the International Fish Exhibition, held in Berlin, it being the special gift of the Emperor of Germany. He also received, in 1875, the decoration of Knight of the Royal Norwegian Order of Saint Olaf, from the King of Norway and Sweden.

Professor Baird received the degree of Doctor of Physical Science in 1856 from Dickinson College, and that of Doctor of Laws in 1875 from Columbian University, being for many years a trustee of the latter institution. Since 1878 he was a trustee of the Corcoran Gallery of Art, and was the president of the Cosmos Club.

He was one of the government Board of Commissioners to the Word's Fair held in Philadelphia in 1876, and member of the international jury on Fish and Fish Products.

He was permanent secretary of the American Association for the Advancement of Science in 1850–51, editing the proceedings of the fourth, fifth, and sixth meetings, and was one of the early members of the National Academy of Sciences, serving as a member of its council almost since its organization.

Besides being a member of the leading scientific societies in the United States, he held foreign or honorary membership in many of the prominent scientific societies in Europe and in the British colonies.

The nomenclature of zoology contains many memorials of his connection with its history. Professor Theodore N. Gill has given his name to one genus of fish and over twenty-five species of mammals, birds, fishes, mollusks, and other forms of life bear his name, together with several fossil or extinct forms of life.

Professor Baird's literary work was something enormous. It included down to January 1, 1882, 1,063 titles.* Of this number, 775 are brief notices and critical reviews contributed to the "American Record of Science and Industry" while under his editorial charge, 31 are reports relating to the work of the Smithsonian Institution, 7 are reports upon the American fisheries, 25 are schedules and circulars officially issued, 25 are volumes or papers edited, while of the remaining 200, the majority are formal contributions to scientific literature.

Dr. Goode states further that, "of the total number of papers enumerated in the list, 73 relate to mammals, 43 to reptiles, 431 to fishes, 61 to invertebrates, 16 to plants, 88 to geographical distribution, 46 to geology, mineralogy, and paleontology, 45 to anthropology, 31 to industry and art, and 109 to exploration and travel."

From 1870 till 1878 he was the scientific editor of Harper & Brothers' periodicals, and likewise the annual volumes of the "Record of Science and Industry" from 1871 till 1879 were edited by him, "with the assistance of eminent men of science." The various reports and annual volumes of the United States Commission of Fish and Fisheries were prepared by him, and also the annual "Reports of the Board of Regents of the Smithsonian Institution."

His other works include the translating and editing of the "Iconographic Encyclopedia" (4 vols., New York, 1852); "Catalogue of North American Reptiles" (Washington, 1853); "Mammals of North America" (Philadelphia, 1859); "The Birds of North America," with John Cassin (Philadelphia, 1860); "Review of American Birds in the Museum of the Smithsonian Institution" (Washington, 1864–66); and "The Distribution and Migrations of North American Birds" (1866). More recently he has been engaged upon a "History of North American Birds," in collaboration with Thomas M. Brewer and Robert Ridgeway (5 vols., Boston, 1874–84). The results of his latest ornithological studies were recently placed by him in the hands of Dr. Ridgeway, and they are now in course of preparation for publication.

In June last, Professor Baird went to Wood's Holl, Mass., the summer headquarters of the U. S. Fish Commission, in greatly impaired health, the result of overwork and anxiety, but it was hoped that, with rest, he would soon be restored to health. For some time he grew better, but early in August he had a serious relapse, from which he rallied with sudden rapidity, and was able to spend part of his time in the laboratory, and even go out of doors. This continued until the day before his death, but on August 19, after a restless night, he became unconscious, and died.

His body was at once taken to Washington and deposited in the receiving vault of the Oak Hill Cemetery, where it will remain until the public funeral, which will occur during the autumn.

It is an unfortunate comment upon the present administration that a partisan clerk was permitted to so "investigate" the office of the U. S. Coast and Geodetic Survey that its superintendent, who had devoted forty years of his lifetime to its work, resigned from his place under threat of exposure of charges, never proved and generally believed incapable of being sustained. Likewise the life of the late secretary of the Smithsonian Institution was "perceptibly shortened," after thirty-seven years of faithful duty, by the careless imputation of the same officer. Although these charges were shown to be without foundation by a Congressional committee, still Professor Baird, "who was extremely sensitive, and who never before heard any imputation against the integrity of his administration, never recovered in spirit from the shock the charges gave him."*

Professor Baird's successor will undoubtedly be the present senior assistant secretary of the Smithsonian Institution, Professor Samuel P. Langley, a sketch of whom appeared in the SCIENTIFIC AMERICAN of August 20, as the president of the American Association for the Advancement of Science during its recent meeting held in New York. The present appointment of Professor Langley was made in January, 1887, at the request of the late secretary, who thus virtually designated him as his successor, and the regents of the Smithsonian Institution, of whom Chief-Justice Waite is chancellor, appointed Professor Langley with that understanding.

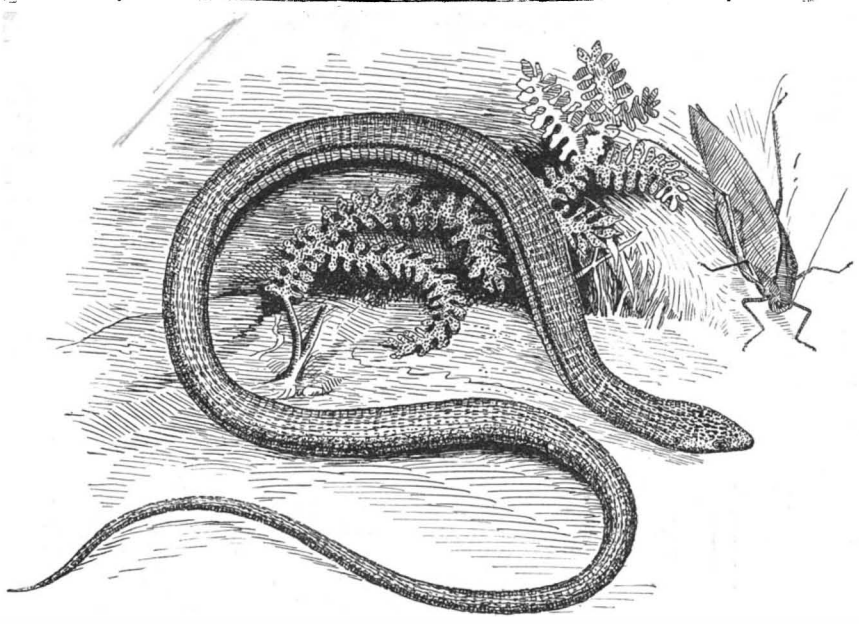
*See "The Published Writings of Spencer Fullerton Baird, 1843-1882," by George Brown Goode, "Bulletin of the U. S. National Museum, No. 20."

THE SNAKE LIZARD, GLASS SNAKE, OR JOINT SNAKE.

(*Ophisaurus ventralis.*)

BY C. FEW SEISS.

A subscriber residing at Davenport, Iowa, writes to the SCIENTIFIC AMERICAN: "I wish you could give us some information through your paper upon the so-called 'joint snake.' I have been permitted to see and kill several of them. They were about two to two and a half feet in length, and were quite pretty, being striped in brown and silver. I once threw a small loamy clod of earth upon one of them, which broke it into eight or ten pieces. Each piece was comparatively square at the ends, and the pieces were all about the same size. I have heard that the broken portions will reunite if left alone, should the head be uninjured. Have I been misinformed?"



THE SNAKE LIZARD, GLASS SNAKE, OR JOINT SNAKE.

The snake lizard, or "joint snake" as it is called in some localities, is a peculiar reptile, and has seemingly puzzled the earlier naturalists as to its proper classification, some placing it among the serpents (*ophidia*), and others with the lizards (*lacertilia*). It is serpent-like in form, being destitute of limbs, but a mere glance at its anatomy proves it to be a true lizard. The lower jaw bone is not disjointed as in the snakes, and the eyes of the snake lizard have movable lids, and its ears are visible externally—characters which never appear in serpents. Its tongue is not slender, forked and sheathed as in the serpents, but is somewhat arrow-shaped, notched in front and covered before with granular, and posteriorily with filiform papillæ. The scales are quadrangular in shape, arranged in transverse rows, and a fold of skin runs along each side of the body, separating the upper from the lower parts.

The tail of a snake or lizard is always considered that portion posterior to the anal opening or vent. The portion anterior to the vent is the body proper, as it contains all of the vital organs, while the tail contains nothing important. In the snake lizard the vent is situated far forward, and the tail is often twice the length of the head and body together. When the reptile is struck lightly, the portion which seemingly is voluntarily broken to pieces is *always the tail*, never the body or that portion anterior to the anal opening. "In many of the lizards the caudal vertebræ have a very singular structure, the middle of each being traversed by a thin, unossified transverse septum. The vertebra naturally breaks with great readiness through the plane of the septum, and when such lizards are seized by the tail, that appendage is pretty certain to part at one of these weak points." The muscles of the tail do not pass over these joints, so that the parting of the tail does not cause a tearing apart of the muscular fibers, but simply a separation of one muscular plate from another.

It has been asked, "Why is the tail of certain lizards so brittle?"—a question that cannot be answered satisfactorily, inasmuch as the vertebræ of the tails of some species of lizards are as strongly bound together as in the serpents. To the snake lizard the fragile tail is a benefit rather than a misfortune, for when the defenseless reptile is seized by a rapacious animal it snaps off its tail into several writhing pieces, which it leaves in the possession of its astonished enemy, while the head and body, the vital parts, wriggle away into the grass and escape. But the snake lizard is not doomed after such a misfortune to pass the remainder of its life without a tail, for it has the power to replace the lost member, not by pasting or cementing together the old broken portions, but by rapidly growing a new one.

When the tail has once been broken, it is hardly necessary to say that it is impossible for the reptile to collect and reunite the pieces.

A certain man declares that he beat a "joint snake" into a dozen or more pieces, and left it for over an hour, and when he returned to the spot he found that "the parts of the snake had come together again and crawled away." He would not be convinced that some animal had carried away or devoured it during his absence, which certainly must have been the case.

A traveler who frequently met with the "glass snake" during his botanical rambles, says: "It is as innocent and harmless as an earthworm. When full grown it is about two and a half feet in length, and three-fourths of an inch in thickness. The abdomen or body part is remarkably short, and it seems to be all tail, which, though long, gradually attenuates to its extremity. The color and texture of the whole animal is much like bluish-green glass, which, together with its fragility, almost persuades a stranger that it is in reality that brittle substance. Though quick and nimble in twisting about, yet it cannot run with much rapidity, but quickly secretes itself in the grass or under leaves." He of course contradicts the "vulgar fable" that it is able to repair itself after being broken into pieces.

In life, the head of the snake lizard is mottled black and green, yellowish about the jaws. The body and tail above are marked with lines of black, green, and yellow, corresponding to the position of the scales. The under surface of the whole animal is yellow, most brilliant along the abdomen. Several color varieties have been described from discolored alcoholic specimens, but in the living animal the color is always as given above, varying only in depth and brilliancy.

It has been found in all of the Southern States from Southern Virginia to Texas inclusive; and in the West its range extends as far north as Wisconsin and Iowa. It seems to prefer open fields and dry or sandy localities, and is frequently met with in sweet potato fields in the South. It is said to feed mainly upon insects.

*Evening Post, August 22, 1887.

To Color Copper and Nickel Plated Objects.

The *Journal des Applications Electriques* says that eleven different colors may be communicated to well cleaned copper, and eight to nickel plated objects, by means of the following bath:

Acetate of lead	300 grains.
Hyposulphite of soda	600 "
Water	1 quart.

After the salts are dissolved, the solution is heated to ebullition, and the metal is afterward immersed therein. At first, a gray color is obtained, and this, on the immersions being continued, passes to violet, and successively to maroon, red, etc., and finally to blue, which is the last color.

As the substances that enter into the composition of the solution cost but a few cents, the process is a cheap one. It is especially applicable in the manufacture of buttons.

Home-made Ice.

Take a cylindrical earthen vessel and pour 3⅓ ounces of commercial sulphuric acid and 1¼ ounces of water into it and then add 1 ounce of powdered sulphate of soda. In the center of this mixture, place a smaller vessel containing the water to be frozen; then cover the vessel, and, if possible, revolve the whole with a gentle motion. In a few minutes, the water in the small vessel will be converted into ice. The same mixture can be used a second or third time for making a block of ice. The operation should, if possible, be performed in a cool place, in a cellar, for example.—*La Science en Famille.*

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COMPOSITION OF VIBRATIONS.

BY GEO. M. HOPKINS.

The optical method of studying sonorous vibrations has the advantage over other methods in being of interest, not only to the student of acoustics, but also to those who care only for beautiful effects, and have no regard for the lessons they teach.

As incidental to scientific work, the effect of beautiful experiments on the latter class may be worth a little consideration, as it not infrequently happens that the mere on-looker is lured into the paths of science by such means.

Among physical experiments, none are more attractive or instructive than those connected with the subject of sound. The experiments of M. Lissajous are particularly interesting, but when the figures are produced by the apparatus employed by Lissajous, a costly set of instruments will be required.

In the annexed engraving are shown two pieces of apparatus for producing these figures; that shown in Fig. 1 being quite inexpensive, that shown in Fig. 2 being a little more costly, and, at the same time, more efficient in its performance.

The device shown in Fig. 1 consists essentially of two plane mirrors, supported by torsional bands of ribbon, one being supported so as to vibrate in a vertical plane, the other in a horizontal plane, the mirrors being arranged with respect to each other so that the light received by one mirror will be reflected upon the face of the other mirror, by which it will in turn be projected through the double convex hand glass, to be finally received on the wall or screen.

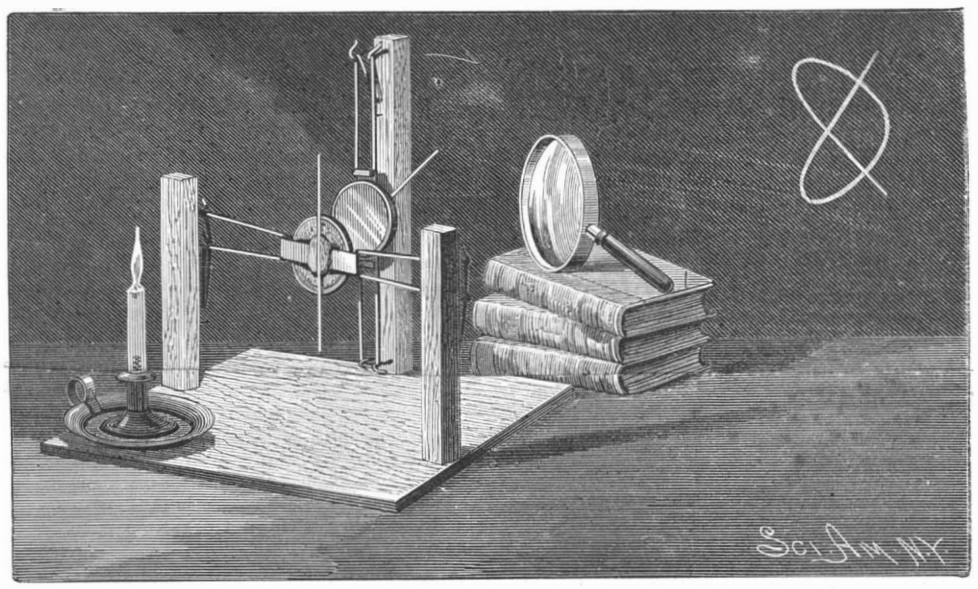

Fig. 1.—SIMPLE APPARATUS FOR PRODUCING LISSAJOUS' FIGURES.

The mirrors employed in the construction of this instrument are the small, inexpensive circular pocket mirrors sold on the street corners. They are about 1½ inches in diameter. To adapt them for use, a strip of tin, having its ends curled up to form hooks, is secured to the back of each mirror by means of sealing wax.

A base board provided with three standards supports the mirrors in the position of use. In one of the posts near the top are inserted two ordinary wire hooks, and near the bottom are inserted two similar hooks. Rubber bands received in these hooks are inserted in the hooked ends of the strip of tin attached to the back of the mirror. Several wire nails are driven into the face of the standard, for convenience in increasing or diminishing the tension of the rubber bands, the bands being drawn forward between the hooks and slipped over one or the other of the nails to increase the tension.

The mirror thus mounted on the vertical rubber bands will, when struck lightly, vibrate in a horizontal plane. To change the rate of vibration, a weight is attached to the back of the mirror by means of beeswax. In the present case the weight consists of a piece of wire about 6 inches long. By varying position of the wire on the mirror, *i. e.*, by placing it at different angles with the rubber bands that support the mirror, the rate of vibration may be greatly varied.

The second mirror is mounted in substantially the same way, the only difference being that the rubber bands are arranged horizontally, and supported by two posts instead of one. This mirror vibrates in a vertical plane, and its rate of vibration is changed in the manner above described. A candle or other source of light is arranged so that the light from it will fall on one mirror and be reflected to the other mirror, which in turn will project it through the lens to the wall. When the mirrors are set in vibration, a figure of more or less complicated character will be produced upon the wall. If the two mirrors vibrate in unison, a straight line, or an ellipse, or a circle will be produced. If one mirror vibrates twice as fast as the other, the figure will have the form of figure 8. The figures may be varied to an almost unlimited extent by changing the tension of the rubber bands, and by shifting the wire weights. As the various figures which may be produced are illustrated in most works on physics and on sound, it will be unnecessary to illustrate them here.

The apparatus shown in Fig. 2 will now be understood with little explanation, as the principle on which it operates is the same as that of the more simple form. The mirrors are each supported by two parallel steel wires, which are really but the ends of the same wire. The extremities of the wire are securely fastened in the T-shaped head of a bolt, which in the case of the horizontal wires extends through one of the posts, and receives a milled nut, by which the tension of the wires may be varied.

The wire at its mid-length passes around a small sheave in the other post, so that as the wire is tightened the tension of its two branches will be equalized. The vertical wires are supported in the same way by studs projecting from the central post—the lower stud being provided with a sheave for receiving the wire, the upper stud being mortised for receiving the tension screw.

The mirrors are attached by small clamps which embrace both wires, and the arms supporting the adjustable weights are pivoted to the clamps. The weights may be swung in the plane of the mirror, and they are made adjustable on their supporting arms.

The best illumination aside from sunlight is that of a small parallel beam from an oxyhydrogen or electric lantern. The apparatus may be coarsely adjusted by turning the weighted arms on their pivots, and a finer adjustment may be secured by increasing or diminishing the tension of the wires.

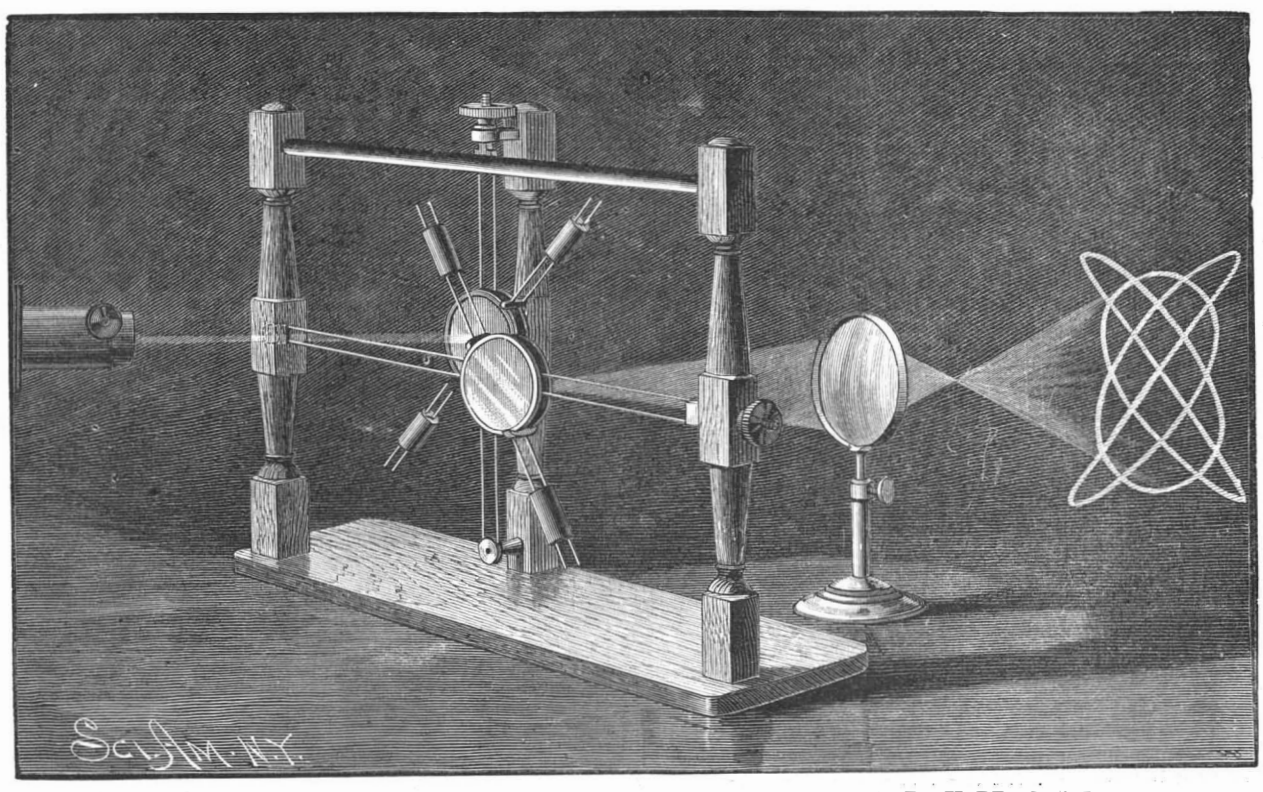

Fig. 2.—APPARATUS FOR COMPOUNDING RECTANGULAR VIBRATIONS.

ANTISEPTIC MOUTHWASH.—One of the greatest living authorities upon buccal bacteriology, Dr. Miller, finds that by using the following mixture he could completely sterilize the mouth, cavities in carious teeth, etc.: Thymol, 4 grains; benzoic acid, 45 grains; tincture of eucalyptus, 3½ fluid drachms; water, 25 fluid ounces. The mouth is to be well rinsed with this mixture, especially before going to bed. For retail, a mixture of water and spirit is required for a presentable preparation, and it should be made much stronger, say five ounces instead of twenty-five ounces, and diluted when required.

Paper.

To properly mix fibers we must know the way they combine to produce paper and the qualities which they should possess to that end. It was a generally accepted idea until very lately that the fibers of the paper sheet close or lock together in the same way as animal hair in felt. At the beginning of this work even, paper is described as a felted sheet. Dr. Wurster sent us at the beginning of the present year the following communication, from which it would appear that paper is not felt in the hitherto acceptation of the word, but simply "a confused mass of fiber." Here is what Dr. Wurster says:

However great progress may have been made in telling what paper is, we have yet no correct explanation of the origin and nature of the paper sheet. It has become a matter of course to consider paper as a felt of fibers, although at the beginning of the century the discoverer of the nature of the felting of animal fibers objected most decidedly to calling paper a felt. The peculiar clinging together occasioned by the animal scales in wool or hair felt, and the intertwining the hair more together by pressure and motion, making the felt thicker and smaller in its dimensions, are lacking in paper fibers.

Merely placing dry paper fibers on one another will not make a sheet of paper, as can be easily seen by using dry rag fiber or lint. Neither will short cut-wool or silk filaments make a sheet of any strength. The capacity for producing a consistent sheet of paper belongs solely to those fibers which lose their elasticity in water as they become softer, but recover that quality again in drying. In the moistened state the ductile fibers, aided by the shaking, settle down in all directions and form a confused fiber mixture. In drying, every fiber gradually recovers it original form and elasticity, and the individual fibers exert a certain pressure on each other. The longer the fibers, and the more intricate the mixture of the fibers when wet, the stronger will be the sheet of paper when dry.

When wet, or when its fibers have lost their elasticity by heat, paper cannot be drawn in every way like felt, in which each hair is, so to say, anchored to another by its scales. A sheet of paper must no longer, therefore, be designated as a felted, but as a confused, mixture of such fibers as are soft and pliable when moist, but hard and elastic when dry. The greater the shaking together of the wet fibers in both directions of the wire, the firmer and stronger will be the sheet. The shorter the fibers, the less pliable will they become with water, as in the case of ground wood, and the less will be the pressure which individual fibers exert on each other, and the more brittle will the paper sheet turn out.

Every strange material mixed with the fibers and then placed between them in the formation of the sheet prevents them from lying close together, thus lessening the solidity of the paper. We shall speak of the results of experiments in this line with sizing, mineral loading, and ground wood in future issues.—*Praktisches Handbuch.*

An English Salt Mine.

The exploration for salt at the Imperial Iron Works, South Bank, near Middlesbrough, for Mr. Coulthard, of London, has just been completed. One bed of salt, 82 feet thick, was penetrated, and a parting of anhydrous gypsum bored through into another bed of salt, 14 feet thick. As the bottom of the salt measures has not been reached, there is the possibility of other beds of salt existing. The total depth of the brine well is 1,692 feet.

TEXAS is well off in dogs, or badly off, rather, for, according to the Galveston *News*, they cost the State $50,000,000. There are 2,500,000 of them. They cost their owners 5 cents a day, or $45,000,000, and they cost sheep owners $5,000,000 more.

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ENGINEERING INVENTIONS.

A steam engine governor has been patented by Mr. Eliphalet L. Arnold, of Montgomery, Texas. It is specially adapted for engines operating saw mills and similar machinery, in which the load is suddenly changed, and provides an attachment which permits of operating the engine to its full capacity when the pressure in the steam chest increases.

A car coupling has been patented by Messrs. Joseph Y. Burwell, of Chico, and Frankie Mammel, of Roxbury, Kansas. The ends of the link are made arrow shaped, and there is a small slot in them, to adapt them to spring into and be held by clamps that are spring-held in the open mouth of the drawhead, with other novel features.

A steam generator has been patented by Mr. John Webster, of Brooklyn, N. Y. The invention covers novel features of construction and the combination of parts in a generator designed to admit water only as fast as it is flashed into steam, and is constructed to cut off the hot gases of the furnace should the feed water supply fail or the pressure become excessive.

AGRICULTURAL INVENTION.

A hay tedder has been patented by Mr. Curtis Gates, of Lyndon, Vt. The frame, supported on drive wheels, carries a crank shaft with a series of oppositely arranged cranks, forks being connected with the cranks and arranged to slide through oscillating guides pivoted in spring-pressed supports, the machine lifting hay from the ground and throwing it into the air for the purpose of separating it.

MISCELLANEOUS INVENTIONS.

A pencil holder for slate frames has been patented by Mr. Robert Holbon, of Alpena, Mich. A receptacle for the pencil is bored in the wooden frame at one side, and a metallic spring is pivoted to cover the opening, the pencil being readily dropped out when the spring is turned to one side.

A scarf holder has been patented by Mr. William P. Clarke, of Winnipeg, Manitoba, Canada. It is made of a plate of metal having hooks on it for engaging the lower edge of the collar and a loop for receiving the collar button, all of the parts being formed integrally of thin sheet metal.

A heating stove has been patented by Mr. David J. Rogers, of Bardstown, Ky. It has a base which extends out from the body or bowl of the stove, with a removable ashpan forming the sides of the base in place of the usual casting, and various other novel features.

A halter has been patented by Mr. Robert D. Whittemore, of Chippewa Falls, Wis. The invention has for its object to provide a means whereby the various portions of a halter may be speedily and readily adjusted to snugly fit any size horse, and be held securely in such adjustment.

A buckle and strap fastening has been patented by Mr. Robert W. Chapman, of Newark, N. J. The invention consists of a buckle permanently secured to the frame of a bag or satchel, with means for securing the strap to the buckle, making a fastening specially adapted for traveling bags, satchels, and other articles.

A lock has been patented by Mr. Benjamin Delvalle, of New York City. It is so constructed that the bolt, its projecting and retracting shoulders, the bolt catch, the unlocking slide bar, and its releasing disks, are all out of reach of the key, so that it is impossible to pick the lock or open it with a false key.

A thill coupling has been patented by Mr. William H. Tibbits, of Crab Orchard, Neb. It consists of a clip having perforated lugs with a pendent stirrup connecting their ends, and other novel features, dispensing with the use of a screw nut on the bolt that secures the thills, and also preventing rattling.

A twine holder and lifter has been patented by Mr. Thomas Porter, of Philadelphia, Pa. This invention includes several novel features, including a revolving twine holder having the rod which lifts the slack fixedly attached to it in distinction to a stationary twine holder and separately moving lifting rod.

A device for controlling runaway horses has been patented by Mr. Isaie Grumbach, of Galveston, Texas. It consists of pads supported by lever arms pivotally connected to the bit, and means whereby the pads may be moved toward each other, so that they will bear upon the nostrils, whereby the rider or driver may apply a pressure to close the nostrils.

A portable fence has been patented by Mr. Davis C. Hapeny, of New Brunswick, N. J. It consists of posts and a series of panels hinged thereto, the build of the sections and the manner in which they are attached to the posts allowing of hard usage with but little wear, the object being to produce a fence specially adapted as a toy.

An improvement in velocipedes has been patented by Mr. James R. Trigwell, of Brixton Rise, London, England. In ball bearing steering joints, this invention provides a retaining device for confining the anti-friction balls to their seats when the neck and head are disconnected, whereby the balls can be conveniently introduced or removed at will.

A device for operating awnings has been patented by Mr. Theophile Charron, of Kankakee, Ill. The invention covers a novel construction and combination of parts whereby an awning may be readily raised and lowered, and wherein the awning, when raised, will be expeditiously and neatly folded up against the building.

A road digger and scraper has been patented by Mr. Alberto Finks, of New Berlin, N. Y. Combined with a wagon frame carrying a scraper bar a concaved scraper blade is also arranged, with an angular point at one end and a gradual taper at the other, both bars being controlled by independent levers, to quickly form and shape the contour of a road.

A nut lock has been patented by Mr. Lavega Self, of Piedmont, Mo. Combined with a fish plate having a flange extending over the foot of the rail, and having a cavity for receiving a spring holder, is a spring holder fitted to the cavity and a spring supported by the holder and adapted to engage the sides of the nuts.

A picture frame has been patented by Mr. William Schumacher, of Brooklyn, N. Y. The moulding is formed with a recess and beads at the edges, in combination with an ornamental facing strip of fabric and a plastic backing embossed with figures and secured in the recess as a separate and independent facing.

A rope coupling or socket has been patented by Mr. Alfred Clark, of Warren, Pa. It is specially adapted to securing a rope or chain to a drill, or to coupling lengths of rope together, and, by this device, the connection is so arranged between the socket and the rope that the latter may be readily removed from the socket without being injured.

A tablet press has been patented by Mr. M. Fairchilds Doud, of Kansas City, Mo. The invention covers novel features of construction and the combination of parts in a press for use in the manufacture of tablets or blocks of stationery, the press being simple in construction and easily operated by persons of ordinary skill.

A back stay fastening for carriage tops has been patented by Mr. Henry E. Horn, of Denver, Col. It consists of a plate set within the back part of the carriage seat on each side and fastened by means of screws, the plate having a number of lugs on the inner side with threaded openings for the reception of screw buttons.

A hand power for sewing machines has been patented by Mr. William P. Clark, of Elberton, Ga. A bracket is connected with the table or some portion of the sewing machine frame, and a hand lever is pivoted on the bracket, connected by a link with the treadle, or with the pitman of the machine, making a cheap and efficient hand power attachment.

A combined shovel and hoe has been patented by Mr. Anton Schad, of Louisville, Ky. This invention provides a simple and inexpensive implement which may be readily converted into either a shovel or a hoe, having locking devices, whereby the blade may be rigidly fixed in line with the handle or be set at an angle thereto.

A regenerative gas lamp has been patented by Mr. Charles E. Bell, of Greenfield, Ohio. The invention covers a combination of tubes with flaring ends, a concaved disk connected with one of the tubes, an apertured ring between the disk and one of the flaring ends, together with a novel arrangement of heating chamber and various other special features.

An edging and joint plate for concrete pavements has been patented by Mr. John C. Hoyt, of Sedalia, Mo. The invention includes the special construction of the joint plates and their fastenings, forming moulds into which concrete or cement is placed and hardens, making an easily laid, cheap, and substantial walk adapted alike for private grounds or thoroughfares.

A blinder attachment for bridles has been patented by Mr. Charles H. Adams, of New York City. The invention consists in providing the blinds with pulleys, and cords passing through them, to be united over the neck and operated with the reins, whereby a horse may be effectually and quickly prevented from seeing, the device to be operated from the saddle or from a vehicle.

An apparatus for moulding perforated blocks has been patented by Mr. Peter McIntyre, of New York City. It is for use with clay, asphaltum, or similar material, and provides a reciprocating follower carrying several penetrating points arranged to be thrust through a moulding box provided with apertures, and adapted to be secured to the frame in line with the penetrating points.

A rounding jack for hat brims has been patented by Mr. Michael Hild, of Philadelphia, Pa. The main frame has a sliding knife stock and sliding adjusting rod attached to the knife stock, in combination with a set screw for locking the adjusting rod, with a guard formed with a tongue in combination with the main frame, and there are various other novel features.

A baling press has been patented by Mr. David L. Hannay, of Greenville, N. Y. The press case has two baling boxes or chambers, one directly over the other, fitted with plungers connected by their pitmen with oppositely set cranks of a shaft journaled in the press case frame, making a novel plunger-actuating mechanism, the press being simple, durable, and "continuous" acting.

A binding clamp for battery electrodes has been patented by Mr. Horatio J. Brewer, of New York City. It consists of a holder having inclined sides fitting on the wedge-shaped end of a battery electrode, with a set screw screwing in the top plate of the holder and firmly securing the holder to the battery electrode, and also holding the wire in a firm contact with the battery electrode.

A neck yoke swivel has been patented by Mr. James M. Colman, of New Castle, Washington Ter. Its construction is such that with it the neck yoke may be turned in any direction in a horizontal plane, and may be swung as desired in a vertical plane by turning it upon its connection with the pole of the vehicle, obtaining a perfectly free and easy motion for the horses.

A machine for winding yarn has been patented by Mr. Benjamin A. Dobson, of Bolton, Lancaster County, England. The invention covers a novel combination and arrangement of parts to stop the winding automatically when the yarn breaks or fails, to provide improved means for regulating the tension on the threads, and to give greater facilities for piecing up the broken threads.

A graduated filing case, especially designed for receiving photographs, has been patented by Mr. Richard M. Hodge, of Princeton, N. J. It consists of an outer box with central longitudinal and transverse partitions, giving spaces for articles to be filed of different sizes, while the connections between the partitions and the case and between upper and lower strips give a frictional contact sufficient to hold them in any position to which they may be moved.

A centrifugal amalgamator has been patented by Mr. William White, of Mount Vernon, N. Y. The invention consists of a pan provided with a number of pockets, which are preferably produced by forming concentric ridges about the axis of the pan, to prevent the mercury from moving in a body to the extreme edge of the pan when rapidly revolved, being an improvement on a former patented invention of the same inventor.

A button fastening machine has been patented by Messrs. Chester L. Olds and John Eklund, of St. Joseph, Mich. It is for fastening buttons on shoes, and in one operation forms the staple from a continuous wire, passes it through the eye of the button, and clinches it in the leather to securely attach the button, the invention covering a machine of peculiar arrangement and construction of parts for carrying out these successive steps.

A vehicle heater has been patented by Mr. Edward A. Olmstead, of New York City. It is more especially applicable as a tramway or street car heater, and has a boiler connected by tubes with a secondary boiler or drum, the boiler mounted within a casing having a fire chamber, below which is a lamp box having a perforated metal diaphragm in its upper portion, the vehicle being heated by the circulation of hot water or steam.

A propeller for boats, ships, etc., has been patented by Messrs. Pius and Karl Kaul, of Brooklyn, N. Y. A vertical paddle is revolved by a crank, and there is an upper guide through which the handle of the paddle slides as its lower end revolves with the crank, the invention covering novel features, whereby the paddles may be adjusted to the depth of the water and the swiveling guide at the upper end of the paddle.

A machine for threading and pointing screw eyes has been patented by Mr. John B. Hardy, of Brooklyn, N. Y. The invention covers a mechanism for feeding the blanks from the revolving hopper to an auxiliary hopper, means for feeding the blanks to the pointer, means for swinging the pointer and pointer spindle laterally to align them with the jaws for revolving the blanks, to point the same and cut the thread, and means for giving the pointer and pointer spindle a longitudinal movement for entering the blank between the revolving jaws.

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The charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

New editions of Trautwine's "Railroad Curves" and "Excavations and Embankments" are now ready. The latter has been out of print for some years. It now appears in very attractive shape, thoroughly revised, and considerably enlarged.

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For the latest improved diamond prospecting drills, address the M. C. Bullock Mfg. Co., 138 Jackson St., Chicago, Ill.

The *Railroad Gazette*, handsomely illustrated, published weekly, at 73 Broadway, New York. Specimen copies free. Send for catalogue of railroad books.

The Knowles Steam Pump Works, 113 Federal St., Boston, and 93 Liberty St., New York, have just issued a new catalogue, in which are many new and improved forms of Pumping Machinery of the single and duplex, steam and power type. This catalogue will be mailed free of charge on application.

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SCIENTIFIC AMERICAN BUILDING EDITION.

AUGUST NUMBER.

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4. The new United States Court House and Post Office, Montpelier, Vermont. Half page engraving.
5. Half page engraving showing Competitive Design for Carnegie Free Library, Allegheny City, Pa., Jas. W. McLaughlin, Architect.
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7. Drawing in perspective, with floor plans, of a Forty-five Hundred Dollar Dwelling.
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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(1) H. H. S. asks (1) some solvent for plaster of Paris which is in small flakes. A. A hot saturated solution of sodium hyposulphite will dissolve plaster of Paris. 2. Something that will dissolve gelatine containing chrome alum, which has set and hardened. A. Use the strong acids. 3. Is there anything that can be mixed with gelatine so that it will set, but not dry or harden? A. We know of nothing except possibly the addition of a large quantity of glycerine. 4. Is there any way to drill a cavity in an artificial tooth without using diamond dust? A. Use the ordinary drill such as dentists use, moistened with turpentine. 5. How do manufacturers of rubber articles get such a fine polish on them? A. They are polished with fine pumice and a stiff brush and finished with whiting and a soft brush or rotten stone and oil. 6. Is there any way that steel can be prepared so it will not rust, and keep a spring temper? A. There are some surface oxidizing processes, such as the Bowers & Barff, but they have not been generally adopted.

(2) B. C. M. desires recipe for stencil paints—black, red, green, and blue. A. Take shellac 2 ounces, borax 2 ounces, water 25 ounces, gum arabic 2 ounces, lamp black a sufficiency. Boil the borax and shellac in water till they are dissolved, and withdraw from the fire. When the solution has become cold, complete 25 ounces with water, and add lamp black enough to bring the preparation to a suitable consistence. When it is to be used with a stencil, it must be made thicker than when it is to be applied with a marking brush. The above gives a black ink; for red substitute Venetian red for lamp black; for blue, ultramarine; and for green, a mixture of ultramarine and chrome yellow.

(3) B. J. H. asks if there is any solution that can be put on a plate glass window to keep flies off. A. Any solution would hurt the appearance of the glass. An infusion of smartweed is partially successful in driving away flies, but its use must be continually repeated.

(4) C. C. H. asks: What is the fall in feet of the Mississippi River from its source to its mouth? A. Lake Itaska, where the riverrises, is 1,575 feet above sea level; the most of the fall is in the upper region; the slope of the high water surface from Cairo to the Gulf of Mexico is 322 feet.

(5) J. W. F. asks (1) how to make a good rosewood stain. A. Take alcohol 1 gallon, camwood 2 ounces, set them in a warm place twenty-four hours, then add extract of logwood 3 ounces, aquafortis 1 ounce; and when dissolved, it is ready for use. 2. A reliable walnut stain for furniture, mostly hardwood. A. Spirits of turpentine 1 gallon, pulverized asphaltum 2 pounds; dissolve in an iron kettle on a stove, stirring constantly. 3. A cheap polish to brighten hard oil-finished work after being rubbed. A. Gum shellac 1 ounce, gum arabic ¼ ounce, gum copal ¼ ounce. Powder and sift through a piece of muslin; put them in a closely corked bottle with 1 pint alcohol, in a warm place, shaking every day till the gums are dissolved, then strain and bottle.

(6) C. G. C. asks why druggists use distilled water? Could they not use common water as well? A. So as to have it as pure as possible. Common water often contains slight quantities of iron, salt, lime, and other ingredients, which render its use undesirable where a pure chemical is needed.

(7) E. M. W. asks for a good cheap liquid shoe polish. A. Take of gum shellac ½ pound, and alcohol 3 quarts. Dissolve, and add camphor 1½ ounces and lamp black 2 ounces.

(8) J. F. A.—See the article on "Canned Food" in SCIENTIFIC AMERICAN SUPPLEMENT, No. 499, also the article "How to Can Asparagus" in SCIENTIFIC AMERICAN SUPPLEMENT, No. 604.

(9) J. H., Jr., desires a receipt for sticking paper to zinc. A. Use starch paste with which a little Venice turpentine has been incorporated, or else use a dilute solution of white gelatine or isinglass.

(10) F. W. L. says: 1. What is the resistance of a 10 and 16 candle power standard Edison lamp and the E. M. F. generally used with each? A. Two standard 16 candle power lamps may be given, and also a standard 8 candle power with following constants:

16 A—70 volts 82 ohms 0·85 amperes.
16 B—32 " 15·4 " 2·08 "
8 B—35 " 41 " 0·85 "

10 candle power lamps are not catalogued. 2. What is the relative resistance between the armature and field of small shunt and series dynamos? Does it make any difference in the above question whether the armature is open or closed coil? If it does, how so? A. No relative resistance of field and armature for dynamos can be given, as it varies in the different makes. The open coil armature normally has the greatest resistance. For examples of both constructions see SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 161 and 600. 3. What is the theoretical advantage of the condenser in an induction coil? A. When a circuit including a coil is broken an extra current is produced, which goes in the same direction as the main current. This to a certain extent in an induction coil defeats its action by delaying the full break of the current. By a condenser this extra current is caught and sent around the coil in the opposite direction to the main current, thus demagnetizing the coil, and improving instead of deteriorating the cut-off. 4. Why is resin used in preference to muriatic acid as a flux, for soldering electrical joints? A. Chloride of zinc flux to which we presume you allude, tends to corrode the wire, on which it is used. This action is not immediate, but slow, and will always occur to some extent unless the joint is cleaned with hot water and dried. Resin is not only non corrosive, but acts as a preventive. 5. Is there any rule by which you can tell the resistance and length of a given weight and gauge of cotton covered wire knowing the weight and gauge of bare wire? If possible, give rule for double covered as well as single covered. A. No rule can be given that would be practical as regards weight. Resistance is unaffected by the coating. 6. What book or SCIENTIFIC AMERICAN SUPPLEMENT gives practical directions for making the different forms of galvonometers and electrometers? A. For manual on this subject, we recommend Haskins' work on "The Galvonometer and its Uses." This we can send you for $1.50.

(11) C. F. D. says: I mail to your address a twig cut from my tree. Is the trouble scale louse, and if so, what is the most scientific and practical way to exterminate them? The tree is twenty feet high, and is literally covered. A. In the absence of Professor Riley Prof. L. O. Howard, of the division of entomology, to whom we referred the specimen, says: The insect upon the twig is a scale louse, and seems without doubt to be the commou peach Lecanium (*Lecanium persicæ*), although the twig is not that of any variety of peach with which I am acquainted. It seems to resemble a cherry, and we shall be glad to receive further information upon this point from Mr. Diller. The remedy for this scale as well as for all others of the same family is to spray the trees, preferably in the spring of the year, with a dilute kerosene emulsion made according to the following formula:

Kerosene	2 gallons	=67 per cent.
Common soap or whale oil soap	½ pound	=33 per cent.
Water	1 gallon	

Heat the solution of soap and add it boiling hot to the kerosene. Churn the mixture by means of a force pump and spray nozzle for five or ten minutes. The emulsion, if perfect, forms a cream, which thickens on cooling, and should adhere without oiliness to the surface of glass. Dilute before using, 1 part of the emulsion with 9 parts of cold water. The above formula gives 3 gallons of emulsion and makes when diluted 30 gallons of wash.

(12) C. I. M. asks: 1. What size and amount of cotton covered copper wire shall I use to make the strongest electro magnet; core of ⅝ inch soft; now using 1 cell (gallon) of blue vitriol battery? A. You should wind your magnet to about four ohm's resistance with as heavy wire as possible. Probably No. 18 will be a convenient size, using three pounds for both legs. 2. Will it make any difference if I use iron washers to hold wire on core instead of hard rubber washers? A. Iron washers will make little or no difference. You must have the ends of the legs finished to a true plane. 3. What kind of battery is best to get strongest magnetic force? A. A bichromate plunge battery is about the best for exhibiting electro magnets. The gravity batteries are of too high resistance and too low electro motive force.

(13) W. H. C. asks (1) what effect steam will have on coiled solid rubber. A. It disintegrates or rots it by a few months' use, according to the pressure or temperature of the steam. 2. Will steam draw the temper from thin tempered steel? A. It will in time, if the pressure or temperature is high, say a hundred pounds or more.

(14) D. S. W. asks: What proportions of camphor, niter, alcohol, sal ammoniac, and water used in making the chemical storm glass? A. Dissolve in alcohol 2 parts camphor, 1 part nitrate of potash and 1 part sal ammoniac. Then add water drop by drop until the mixture begins to grow a little cloudy. The solution is then ready for introduction into the tube. Another formula is the following: Dissolve 2½ drachms camphor in 11 fluid drachms of alcohol. Dissolve 38 grains of nitrate of potash and 38 grains of sal ammoniac in 7½ fluid drachms of water, mix the solutions.

(15) C. D. asks the amount of curvature in one mile of ocean surface. A. $2\frac{4}{10}$ inches.

(16) E. T. H. asks (1) how to make a powder which, when added to water, will form an agreeable lemonade. A. Take 1 pound finely powdered loaf sugar, 1 ounce tartaric or citric acid, and 20 drops essence of lemon. Mix and keep dry. Two or three teaspoonfuls of this stirred briskly in a tumbler of water will make a pleasant lemonade. The addition of 1 ounce of carbonate of soda to the above renders it effervescent. 2. A silicate varnish for paper which will render it erasable for lead pencils. A. Such varnish is a secret preparation.

(17) C. F.—Galvanized iron pipe is largely used for water supply to houses. It is not more dangerous than lead pipe, but both should have their contained water discharged after standing a few hours Plain iron pipe also shows rusty water, after water has remained in pipe a few hours, and is also liable to fill up with rust nodules in two or three years, if the pipe is small, say ¾ inch or less.

(18) T. M. S. asks (1) the process of cleaning brass gun shells. A. For such as have been used, boil in a strong solution of caustic soda, rinse in hot water, then dip in a hot pickle of sulphuric acid 1 part, water 4 parts, and rinse in hot water. 2. The process of polishing tool handles. A. Polish by rubbing with turnings or with the end of a piece of wood while in the lathe, or, in quantities, by tumbling with turnings. A splint brush revolving very fast is sometimes used for polishing single articles.

(19) W. C. I. asks: What would be the difference in sustaining power, or crushing weight, between two cast iron columns each 10 feet high and 6 inches diameter, one made solid, the other cast hollow, the shell being 1 inch thick? A. The crushing value of the solid column is two and a half times greater than the hollow column as stated.

(20) C. E. M. asks the size and form of bellows used in hand organs. A. They are about 10 inches wide, 20 inches long, and are hinged at one end and double like a forge bellows.

(21) M. S. G.—There is no truer or better means of finding the actual horse power of an engine than by taking indicator cards of both strokes and ascertaining by them the mean engine pressure. This, multiplied by the speed of the piston in feet per minute, dividing the product by 33,000, gives the accepted horse power. Otherwise the area of the piston is multiplied by the boiler pressure, less the assumed coefficient by expansion and loss of pressure from boiler to engine, in place of the mean engine pressure by card. The coefficients computed for various degrees of cut-off may be found in the "Engineer's Handy Book," Roper, which we can mail for $3.50.

(22) J. C. M. asks how to get a fine polish on such stones as quartz, granite, etc., to use them as specimens in a cabinet. A. Grind the required surface on a grindstone. Let the last grinding be very light. Then rub with ground pumice stone and water on an end piece of wood, or a piece of sole leather. until a partial polish is obtained. Finish on a piece of sole leather, with oxide of tin or rouge, wet.

(23) G. N. W. asks for a recipe for a good black stamping ink for tracing cloth, one that will not rub off, for rubber or metal stamps. A. Try the following: Dilute 1 part of coal tar with 1 part of benzine, and stir into it one-tenth part of lampblack. Mix into a homogeneous paste, which is then ready for use. By adding more or less benzine it can be given any consistency desired.

(24) C. H. T. asks the easiest way to make holes through an oyster or clam shell. A. Drill the holes with a hard, sharp steel drill, the same as used for drilling iron. Use the drill dry.

TO INVENTORS.

An experience of forty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

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August 16, 1887,

AND EACH BEARING THAT DATE.

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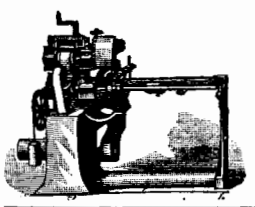

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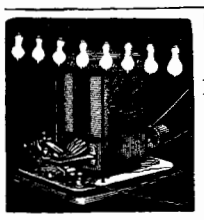

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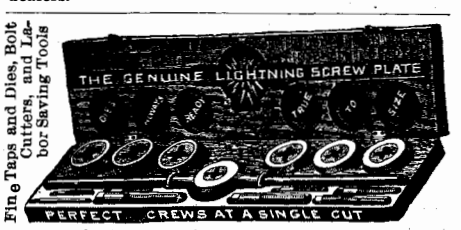

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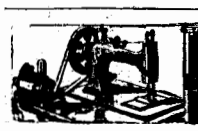

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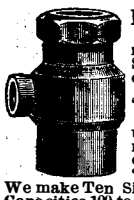

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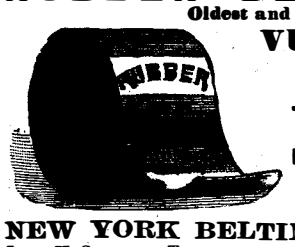

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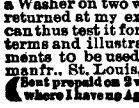

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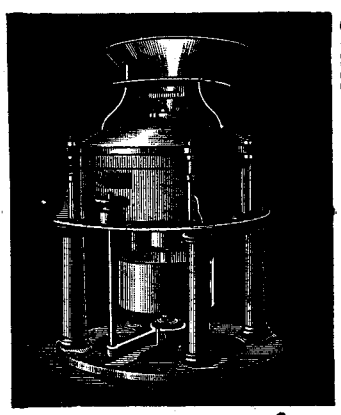

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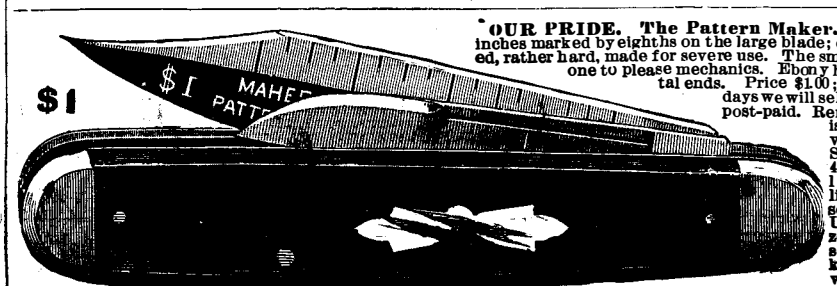

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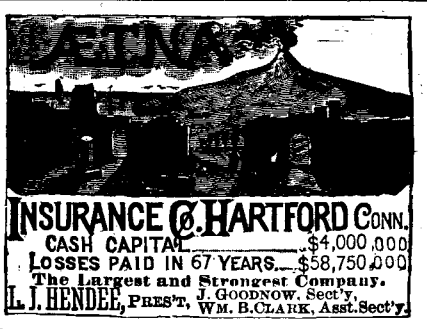

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Proposals for Steel-cast Guns for the Navy.

NAVY DEPARTMENT,
WASHINGTON, D. C., *June* 28, 1887.

Under authority conferred by the act of Congress, approved March 3, 1887, making an appropriation "for the purchase and completion of three steel-cast, rough-bored and turned, six-inch, high-power rifle cannon, of domestic manufacture, one of which shall be of Bessemer steel, one of open-hearth steel, and one of crucible steel," sealed proposals from domestic manufacturers, to furnish the same, will be received at this Department until Tuesday, the second day of August, 1887, at 12 o'clock noon, at which time the proposals will be opened.

Proposals may be made either to furnish three completely finished six-inch, breech-loading, high-power rifle cannon, made from unforged castings, one of Bessemer steel, one of open-hearth steel, and one of crucible steel, or three unforged, rough-bored and turned castings for such cannon, of the same material respectively, furnished by the Department in accordance with the bidder's design.

* * * * * * * *

No gun or casting for a gun will be paid for until the gun "shall have been completed and have successfully stood the statutory test required by the act of July twenty-sixth, eighteen hundred and eighty-six," entitled "an act making appropriations for the naval service for the fiscal year ending June thirtieth, eighteen hundred and eighty-seven, and for other purposes." [For statement of requirements of said tests, and of other conditions to be observed, reference is made to "specifications" which can be had upon application to the Department.]

Proposals may be made for one or more guns or for one or more castings as aforesaid, * * * [but must be made separately for each gun, or casting for a gun, and upon forms prepared by the Department.]

Each successful bidder will be required to execute, within fifteen days after notice of award, a formal contract in accordance with his proposal, and to furnish a bond, with satisfactory sureties, in a penal sum equal to fifteen per cent. of the amount of his bid, conditioned for the faithful performance of such contract.

Copies of the specifications, with blank forms of proposals, and all additional information desired, can be obtained on application to the Bureau of Ordnance, Navy Department.

All proposals must be in duplicate, inclosed in envelopes marked "Proposals for Steel-cast Cannon," and addressed to the Secretary of the Navy, Navy Department, Washington, D. C.

The right is reserved to waive defects in form and to reject any or all bids.

WILLIAM C. WHITNEY,
Secretary of the Navy.

NAVY DEPARTMENT,
WASHINGTON, D. C., *July* 20, 1887.

In order to give more time to domestic manufacturers to consider the matter, the period limited for the reception of proposals for steel cast guns is hereby extended, and such proposals will be received, under the foregoing advertisement, as modified, until Tuesday, September 20, 1887, at 12 o'clock noon, at which time the proposals will be opened.

WILLIAM C. WHITNEY,
Secretary of the Navy.

Proposals for three Overhead Travelling Cranes complete, three Supports for such Cranes, and one Iron Frame for a Building.

NAVY DEPARTMENT,
WASHINGTON, D. C., *July* 23, 1887.

Sealed proposals will be received at the Navy Department, Washington, D. C., until 12 o'clock noon, on Thursday, the 15th day of September, 1887, at which time and place they will be opened in the presence of bidders, for furnishing the necessary material and labor and constructing, delivering and erecting the iron work for the supports of three overhead travelling cranes, the frame of one building, and three overhead travelling cranes complete, including attachments pertaining thereto, for the Ordnance Gun-shops at the Navy Yard, Washington, D. C., in accordance with plans which may be seen, and specifications, copies of which, together with all other information essential to bidders, may be obtained at the Office of the Civil Engineer at said Navy Yard. Proposals must be made in accordance with forms which will also be furnished on application to that Office.

Proposals must be made in duplicate and inclosed in envelopes marked "Proposals for Overhead Travelling Cranes complete, for Iron Supports for such Cranes, and Iron Frame for a Building," and addressed to the Secretary of the Navy, Navy Department, Washington, D. C.

The Secretary of the Navy reserves the right to reject any or all bids, as, in his judgment, the interests of the Government may require.

WILLIAM C. WHITNEY,
Secretary of the Navy.

Proposals for Steel Gun-Forgings for the Navy.

NAVY DEPARTMENT,
WASHINGTON, *August* 13, 1887.

Sealed proposals, from domestic manufacturers of steel, to furnish twenty-two sets of steel forgings for 6-inch B. L. rifle guns, all oil-treated, annealed, and in accordance with drawings and specifications prepared in the Bureau of Ordnance, will be received at the Navy Department until Tuesday, the 27th day of September, 1887, at 12 o clock, noon, at which time the proposals will be opened.

The kinds of forgings required and the estimated quantities of each (aggregating about one hundred and thirty-six tons), are set forth in the specifications, which, together with blank forms of proposals and of contract, and copies of the drawings and any other information desired, can be obtained on application to the Bureau of Ordnance, Navy Department.

The contract will be awarded for the forgings as a whole. No proposal for less than the whole will be entertained, nor will any proposal be considered unless accompanied by satisfactory evidence that the bidder is in possession of a plant adequate to the production and delivery of the required forgings. All the forgings delivered under the contract must conform in material, manufacture, and quality to the aforesaid drawings and specifications, and must successfully pass the required inspection and tests.

The successful bidder will be required, within ten days after notice of award, to enter into a formal contract binding himself to deliver one set of gun-forgings not later than December 31, 1887, and not less than one set every twenty-one days thereafter, and to complete the deliveries within fifteen months from the date of the contract. A bond, in a penal sum equal to 15 per cent. of the total contract price, must accompany the contract.

Each proposal must be accompanied by a certified check, payable to the order of the Secretary of the Navy, in an amount not less than 5 per cent. of the total amount of the bid. Checks of unsuccessful bidders will be returned within five days after the bids are opened. The check of the successful bidder will be returned when he shall have executed the formal contract and furnished the requisite bond. In case of his failure to comply with this stipulation, the check will become the property of the United States.

All proposals must be in duplicate, enclosed in envelopes marked "Proposal for Steel Gun-Forgings," and addressed to the Secretary of the Navy, Navy Department, Washington, D. C.

The right is reserved to waive defects in form and to reject any or all bids.

WILLIAM C. WHITNEY,
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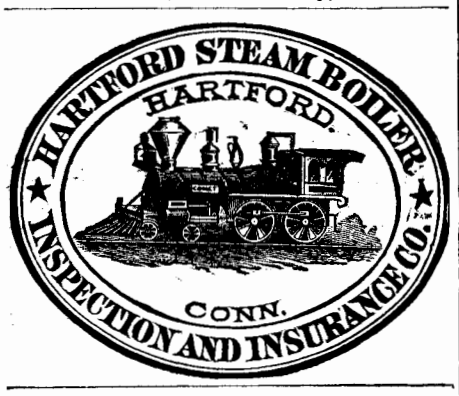

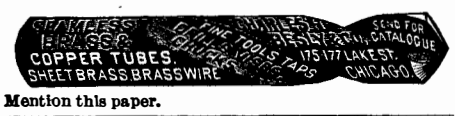

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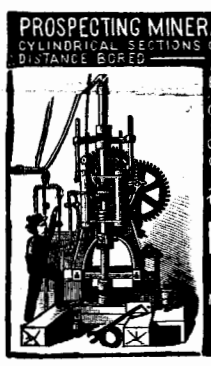
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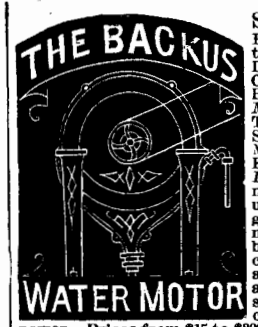

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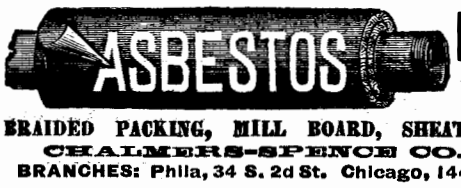

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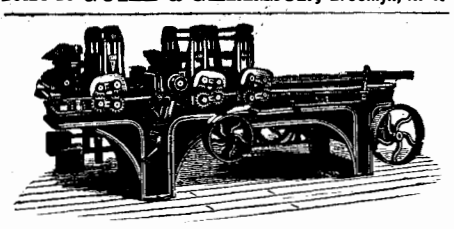

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